THE MODEL ENGINEER

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THE MODEL ENGINEER

EVERY THURSDAY

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Our Cover Picture

The photograph reproduced here depicts an interesting machining operation in the construction of the General Purposes Lathe described elsewhere in this issue. Apart from the merit of this particular design of lathe, which undoubtedly has a wide range of utility for both wood and metal work in the home workshop, the subject of lathe construction generally is one of great interest to our readers. The fact that the lathe is the most essential machine tool, and in many cases the only machine tool, used by the amateur, has caused a great deal of attention to be focussed on the possibility of constructing the lathe itself in the workshop. Many times in the past we have published articles on home-built lathes, varying from the simple and primitive to the elaborate and precise, and we have plenty of evidence that most of these lathes have served their purpose well, within their capacity, and fully justified the pains taken in their production. The greatest deterrent to lathe construction is the necessity for machine tool facilities in producing accurate components, but this can often be overcome by the use of equipment available in club or school workshops.

SMOKE RINGS

Enter Volume 110

HERE, ONCE more, is the first issue of a new volume, and with it we enter our fifty-sixth year. While we do not claim that this long service to our readers is a journalistic record, we *do* claim that THE MODEL ENGINEER has progressively developed until its position and prestige are unique in what we will call hobby journalism. It is produced by a staff of practical model makers who, of course, understand the needs and desires, the problems and difficulties of model engineers everywhere, and whose aim is to satisfy all readers. We sometimes take up Volume 1 and look it through, and invariably it arouses a feeling of admiration at the courage and enthusiasm so plainly apparent in its pages. The courage and enthusiasm are no less today than they were fifty-five years ago, though the circumstances and conditions in the field in which THE MODEL ENGINEER circulates are totally different now from what they were then. With this always in mind, and with the determination to keep pace with whatever changes may take place around us, we cross the threshold of each new year.

Thank You !

ONCE AGAIN, we have received many greeting cards and messages of good will from readers, known and unknown, in almost every country in the world. We can but express our pleasure and gratitude, since it is impossible for us to acknowledge each greeting individually. Most heartily we reciprocate the good wishes, and we hope that readers everywhere will enjoy another twelve happy months of making and running models of all kinds. After all, ours is the most rewarding of hobbies in all its various phases.

Where's Nurse ?

FROM THE *Journal of the Society of Model and Experimental Engineers* we extract the following, among some amusing comments overheard at the "M.E." Exhibition.

"Another remark . . . was that Commander Barker's side lever engine was an organ blower in a cathedral. Sometimes one almost despairs for the future of the human race."

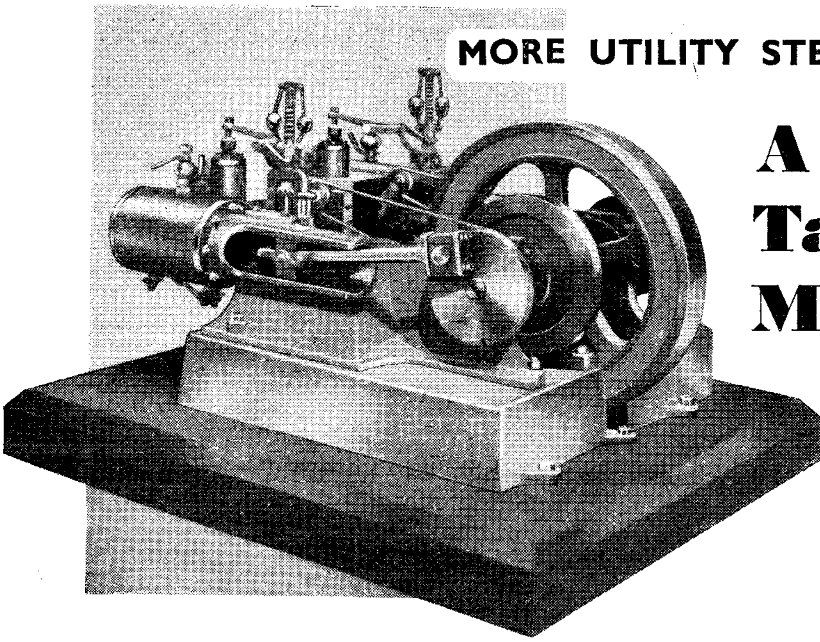
At first sight, we agreed with the last sentence, for it seemed to us that the interpretation of Commander Barker's masterpiece could only have come from one who ought not to be allowed out without a nurse !

On second thoughts, however, was it not indicative of brilliant inventive genius ? We can imagine the speaker being suddenly asked, "What is that ?" and not having the foggiest notion what to reply, suggested the only thing that the beautiful model, in its turn, suggested to him ! For all we know, his reply saved him from being looked upon as a complete ignoramus, thereby avoiding a family feud. If we are right, the future of the human race may be in no jeopardy. But it was a near thing !

News from Plymouth

WE HAVE received a letter from Mr. J. Hammond, hon. secretary of the Plymouth and District Society of Model and Experimental Engineers, enclosing a copy of the fixture-list which gives the dates of all meetings up to and including July 16th, 1954. It gives the titles of what would appear to be some excellent lectures, covering many different subjects, ranging from "Glassmaking" to the "History of Plymouth."

In his letter, Mr. Hammond tells us that the society is now in possession of enlarged headquarters, which are in the grounds of the former Stoke Military Hospital, and the amenities include: a permanent car race track and a ship tank, both indoors, while there is a workshop complete with power-driven lathe, drill, etc. At present the members are building the "M.E." power hacksaw. There is evidently no lack of enthusiasm in Plymouth.



MORE UTILITY STEAM ENGINES

A Double Tangye Type Mill Engine

By

Edgar T. Westbury

THE engine I am now about to describe has been adapted from an old " M.E." design, and although I have not actually built it myself, I have no doubts whatever regarding its success. Its popularity also, should be fairly assured, as the type is one which has been universally admired by model engineers; it is complicated enough to be really interesting, while involving no very serious problems in construction, and capable of being made with relatively simple workshop equipment. Castings for this engine were once available from the Liverpool Castings & Supplies Co., a firm which was noted both for sound quality and design, but which unfortunately has been out of business now for many years. A description of an engine of this type built by the late Mr. William Ballantyne, appeared in the issues of THE MODEL ENGINEER dated June 8th, 15th and 22nd, 1933, and this information has been freely drawn upon in this reconstruction of the design, though it has also been necessary to carry out further investigation, in order to obtain the most authentic particulars of all details.

The prototype of this engine was the product of a firm which has played a very important part in engineering development and progress from the very beginning of the industrial era. It is not without significance that one of their best known inventions, the hydraulic jack, has been in production for over a hundred years with very little alteration in design, and is in larger demand than ever at the present day —surely a record for any important engineering product ! In the course of their history, Tangye's have made engines and power plant of many widely different types, including not only steam, but also gas and oil engines, and are at present well up-to-date with modern developments, in the production of industrial diesel engines.

The particular type of engine represented in this design was produced some fifty or sixty years ago (exact date cannot be ascertained) and at the time was one of the most advanced designs in its class for driving factory machinery and similar purposes; it was not a very large engine, as most industrial power requirements in those days were relatively modest, compared with present-day conditions. Its small size thus makes it very convenient for scaling down to make an accurate model with no sacrifice of detail.

Note, that although it had two cylinders of equal size, of the " simple " type, as distinct from " compound " or two-stage expansion type, it was not known as a " twin-cylinder " engine, but as a " double " engine, because it consists virtually of two complete engines, arranged right- and left-handed as mirror counterparts of each other, each with its own valve-gear, governor and throttle valve. It is thus possible to separate the two halves, with little or no alteration of the essential parts, and to make them up as right- or left-handed single engines. The only components affected are in fact the bedplate and the crankshaft journal. Several single cylinder models of this type have been built, and I discovered one on the S.M.E.E. stand at the last " M.E." Exhibition, but was unable to ascertain the name of the constructor.

One of the practical advantages of double engines having readily accessible working parts, as in this case, is that by disconnecting one crankhead bearing and eccentric strap, the engine may be run as a single, and steam economy, thereby, improved when running on relatively light loads. In some instances overhauls have been carried out on the cylinder and motion work of the idle cylinder while the other is still capable of coping with half the maximum load, thereby avoiding a complete shut down of the plant. This consideration, of course, is of no importance in a model, and is mentioned only to explain why such features are employed in full-size practice.

In the course of my quest for accurate information on the design, I approached Tangye's Ltd., in the hope that they might be able to produce some old catalogues or other illustrations and specifications, but they were unable to help me, as they informed me that all the old records had been lost, and that no engine of a type resembling this was available for inspection, so far as they were aware. This is very much to be deplored, as a firm with such

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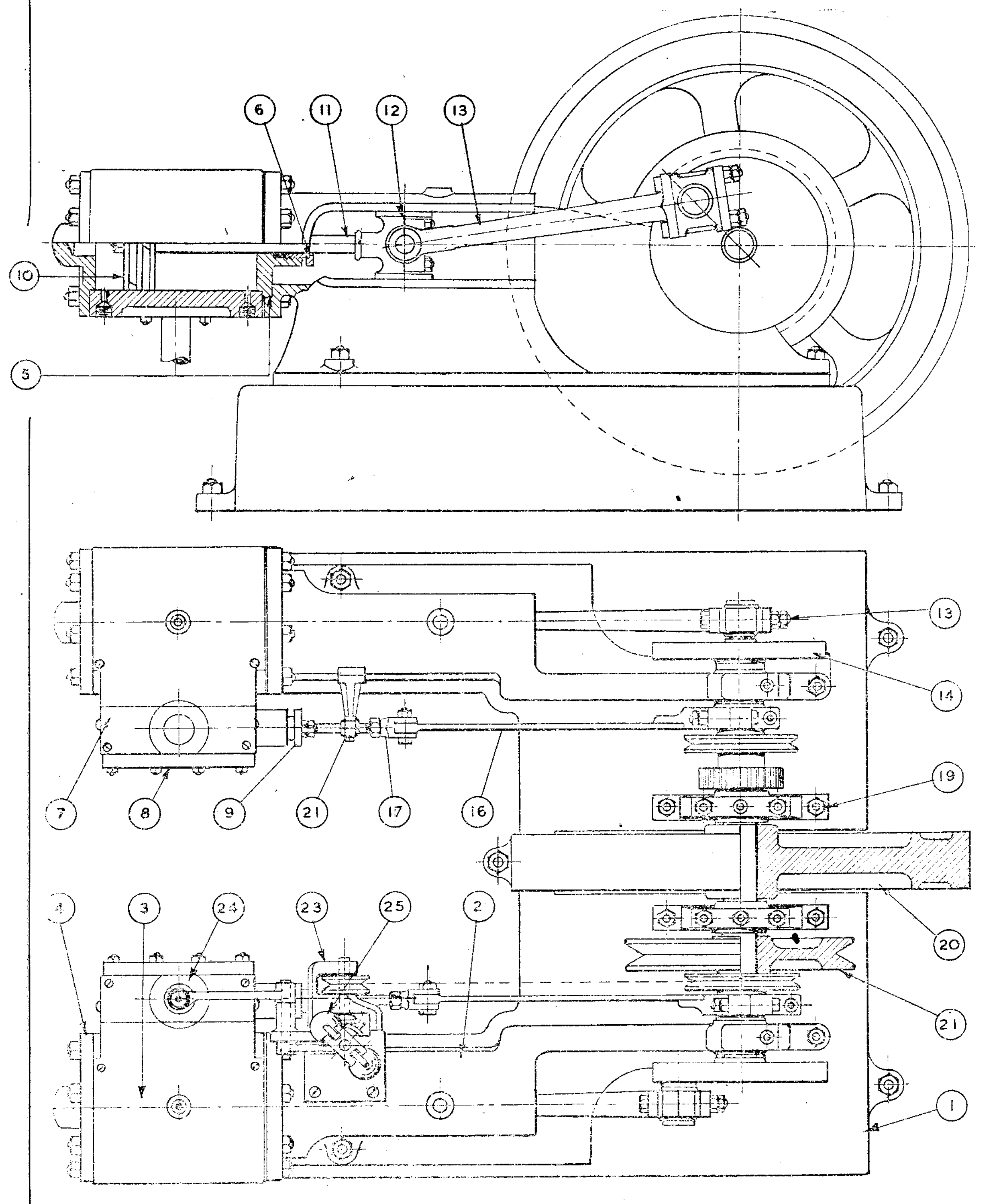
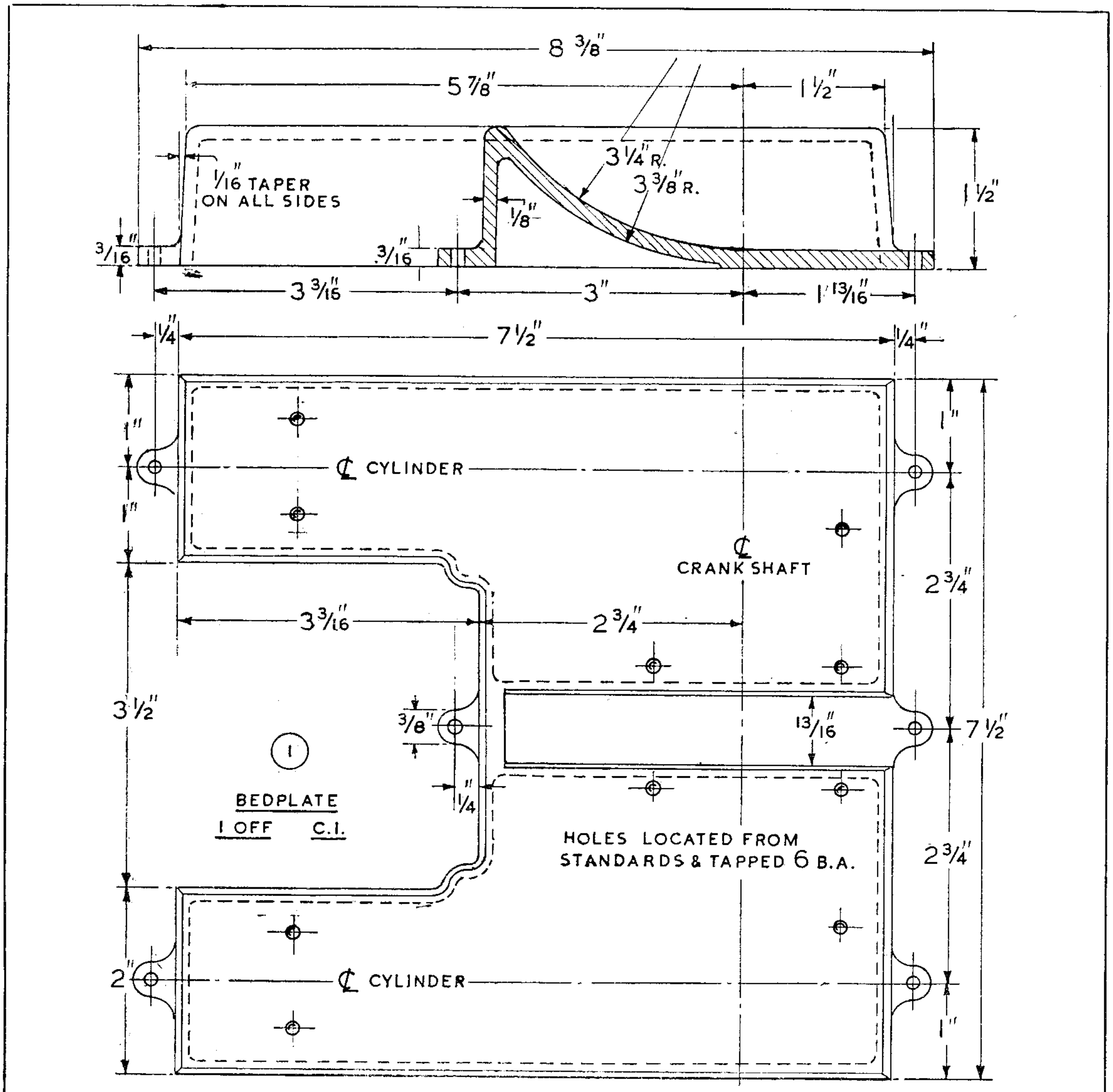


Side elevation and plan of Double Tangye engine, $1\frac{1}{8}$ in. bore by $1\frac{1}{2}$ in. stroke



Elevation and plan of bedplate

an illustrious history as this should have some lasting memorial of its past achievements. So many notable engines and inventions, which played their part in building up the vast industrial machine of the present day, have passed or are rapidly passing into oblivion, that many modern sophisticates hardly know or care that they ever existed. While I am not by nature an antiquarian, being far more keen on wrestling with modern problems, I have a profound respect, amounting to reverence, for the pioneers of engineering and their noble works; and hardly less so for those model engineers whose labours of love help to keep the memory of these works, if not their authors, alive.

The castings for this model will be available from Messrs. A. J. Reeves Ltd., of 416, Moseley Road, Birmingham 12, who are also well known for the quality of their model engineering supplies.

Construction

I do not propose to give minute details of all operations in the construction of the engine, as the majority of them are very similar to those employed in the " Unicorn " engine and can be dealt with in much the same way. There are, however, one or two components which may be found somewhat more difficult to handle with limited equipment than those of the above engine, and these will be given more detailed attention. Some of the parts, notably the bedplate, are too large to be machined on a lathe of the size likely to be available to most readers; but on the other hand, the necessary work on them can practically all be carried out without the assistance of any machine tools at all, if one is prepared to use a file and scraper as an alternative. I must admit that I very much prefer machining to

hand work, but there are many model engineers to whom the latter appeals, and who have the skill and patience to carry it out.

Bedplate

This, of course, is the largest single casting in the entire assembly, and in common with most other structural parts, is specified as made in cast-iron, but this particular item might well be made in light alloy, as it is not necessary for any bright finished surfaces on it to be visible, and this would very much simplify machining. Alternatively, it would be possible to fabricate it from sheet steel or other materials. Apart from drilling and tapping holes, it is only necessary to true the underside rim to produce a reasonably flat seating for mounting on wood or other suitable material, and machine or otherwise true up the whole of the top surface to a more exacting degree of precision, so as to ensure the lining up of other machined parts.

A planer or shaper is the most suitable machine tool for dealing with this surface, but if a lathe capable of swinging not less than 12 in. diameter on the faceplate is available, it will do the job quite efficiently. In either case, however, it will usually be found advisable to finish the surface by hand scraping, to take out all tool marks, and check the flatness by means of a surface-plate. With the exception of the holes in the lugs for the foundation bolts, drilling and tapping can be deferred till other parts are ready. The centre-lines for the two cylinders and the crankshaft should be clearly and accurately marked out, to enable the other structural parts to be correctly located.

Trunk Standards

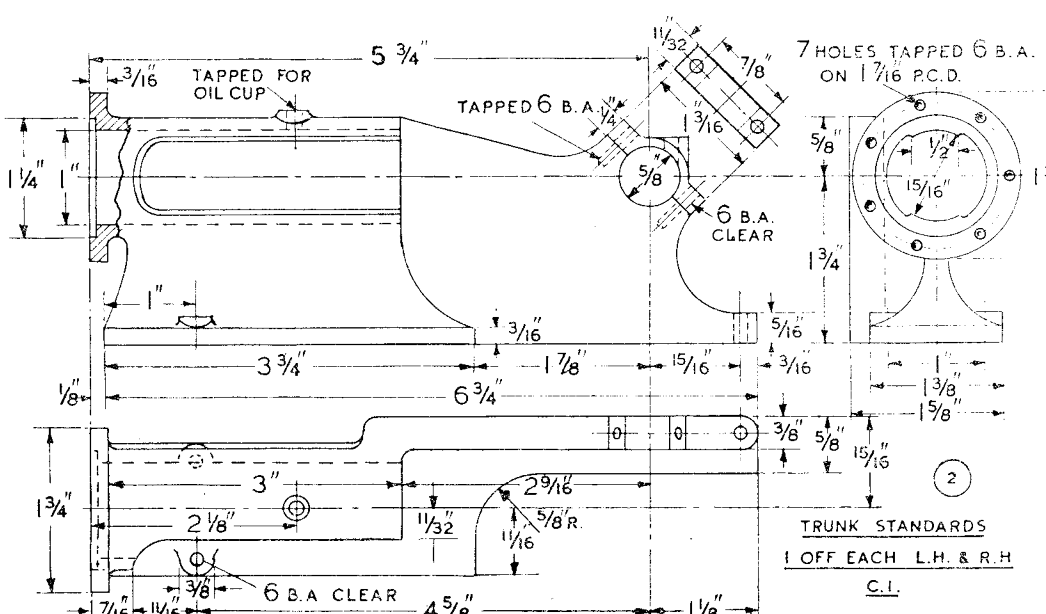
The shape of this casting makes it somewhat awkward to handle with limited equipment, but the essential machining operations can be carried out in a 3½-in. lathe with a little scheming. There are two castings, right-hand and left-hand respectively, for the double engine, but the methods of machining are, of course, the same in each case. It is best to start by filing or otherwise truing up the vertical back face of the casting, so that it can be used as a bolting face; full machining of this surface is not allowed for, as it is not essential in other respects. It is now possible to clamp the casting by this face on a large angle-plate, for facing the base surface, or alternatively, on the lathe cross-slide, for milling or fly-cutting; the latter is probably the more convenient on a small lathe. It will be found desirable to steady the cylinder flange end of the casting by bolting an angle bracket against it, using a long bolt through the cored trunk guide and a plate at the outer end. The foot of the bracket is bolted down to the cross-slide before the long bolt is tightened.

A check on the main dimensions should be taken to ensure that the base surface of the casting is machined to a distance of 1¾ in. to the centre-line passing through the trunk guide and main bearing axes, and care should be taken to machine both castings exactly alike in this respect.

The boring and facing of the trunk guide could also be carried out by mounting on an angle-plate on the faceplate, but owing to the long overhang, it would not be a very satisfactory form of mounting except on a pretty large lathe. A possible way of steadying the casting for boring would be to begin operations by truing up the outside of the cylinder flange, taking very light cuts to avoid forcing or springing it out of truth, and then rig a steady of some kind for it to run in. It might, however, be found difficult to use the orthodox form of three-point steady, owing to the projection of the base flange, which might cause it to foul.

In the circumstances, I should favour the alternative method of boring the guide by mounting it on the cross-slide, and using a bar between centres. If a standard packing piece is made to adjust the casting to the required height, this will enable the same method to be employed for boring the main bearing housing in this casting, and also the separate main bearing bracket, with the assurance that these bores will all come out at exactly the same height from the base surface, which is essential for correct lining up.

On the Myford ML7 lathe, the



TRUNK STANDARDS
1 OFF EACH L.H. & R.H
C.I.

height from the cross-slide surface to the mandrel axis is $2\frac{1}{16}$ in., so that a packing piece $\frac{5}{16}$ in. thick can be used to mount the casting so as to ensure that the axis of the bore is $1\frac{3}{4}$ in. from the base line. It is advisable to use a piece of plate large enough to cover the full length and width of the base, at least, with holes drilled and tapped at convenient places for clamping, in addition to through holes for tee bolts to hold it on the cross-slide. Any old piece of metal plate can be used so long as its surfaces are reasonably flat and parallel; if additional packing must be used, it should be of metal, and large enough to ensure positive bedding down. It is helpful to drill the fixing holes in the castings to assist in bolting down, though additional clamps will also be required.

Before carrying out the boring operation, the main bearing housings, both on this and the separate casting, should be prepared for boring, so that they can all be dealt with together; the sequence of operations, therefore, is not in the order described, but we may as well deal with the business of boring the guides straight away. It is always sound policy to use as stiff a boring bar as possible in these operations, and here it is possible to use one $\frac{3}{4}$ in. diameter; the length, on the other hand, should be kept as short as possible, consistent with obtaining the necessary length of traverse. In this case, it is possible to extend the tailstock barrel so that the centre point almost reaches the mouth of the guide, so that a bar having an effective *working* length (i.e. excluding the means of driving it) of about $6\frac{1}{2}$ in., with the cutter mounted about in the centre, should be sufficient.

Although this method of boring is generically described as "between centres," I nearly always prefer to hold one end of the bar in the chuck, as this improves its rigidity by providing cantilever support at this end. I also prefer to fit the cutter obliquely in the bar, even when it can pass clear through, because this enables a longer cutter bit to be used, with longer bearing in the hole, and incidentally gives finer cut adjustment. It is immaterial whether the bit is of round or square section, but the former is the easier to fit, and round high-speed cutter bits are obtainable, if one is not satisfied with silver-steel, though personally, I find this quite adequate for a job of this nature. The boring bar may be either simple or elaborate, even to the inclusion of fine adjustment, with micrometer setting, to the cutter, according to time one is prepared to devote to toolmaking. But I find that life is too short to make all the gadgets one would like to have in the workshop—and the pocket much too shallow to buy them. The simple tools will do the job, with the exercise of a little care and patience in using them; I have done a good deal of boring to fine limits of precision with cutters having no other means of adjustment than that obtainable by tapping the cutter through the bar, and locking with a grub-screw.

If the core of the trunk guide is cast as shown on the drawings, the cut will be intermittent, and will have to be taken cautiously, with slow speed, in the roughing-out stages. There would, however, be no objection to using a circular core, though even then the intermittent cut would not be avoided owing to the cutaway at the front of the guide. It is, for this reason, impracticable to use a floating or other kind of reamer for finishing the bore, but a special bar with a fixed double-ended sizing cutter could be used, to ensure uniformity in the diameter of the two guides. In any case, but particularly where a single-point cutter is used, the bar should be run through the bore several times without increasing the feed, to eliminate spring and produce as high a finish as possible. The cutter should be keen and well rounded at the tip.

By using suitable cutters it is possible, at the same setting, to machine the face of the flange and also the recess, but it will generally be found more satisfactory to do this by mounting the casting on a mandrel, as flat faces are difficult to finish nicely with a boring bar, owing to the broad cut inducing a liability to chatter—unless, of course, one has a boring head with radial traverse. The mandrel also enables the outer edge of the flange to be turned, and by using a bent narrow-nosed tool, allows of back-facing the inner side of the flange, to form a true sealing for the cylinder nuts.

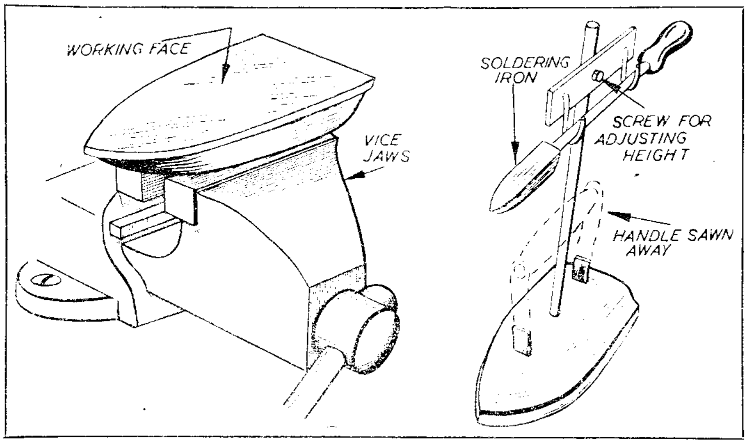
(To be continued)

USEFUL TOOLS FROM SCRAP

THE accompanying sketches show two useful tools made from an old discarded domestic smoothing iron.

First for use as an anvil, the handle was sawn off midway, leaving two lugs which could be squarely held in the vice jaws; the body of the iron formed a useful working surface for straightening or flattening material or centre-punching small items.

The second use the iron was put to was to serve as a base for a soldering-iron support, in conjunction with an ordinary blow lamp. A $\frac{1}{4}$-in. tapping hole was drilled centrally in the upper face of the iron, and fitted with a brass or steel rod. A short piece of $\frac{5}{8}$-in. or $\frac{1}{2}$-in. square section was drilled to slide on the rod, making the height adjustable, and being secured by a $\frac{3}{16}$-in. screw. Two small hooks were attached to the cross-piece to carry the soldering iron and this completed a useful addition to the workshop. It should be noted that the screwed rod should be only finger tight so as to enable it to be removed readily, when required to use the base as anvil.—P. Robinson.



IN THE WORKSHOP

BY DUPLEX

TUNGSTEN-CARBIDE TIPPED TOOLS

TOOLS tipped with Tungsten-carbide are largely used in production engineering, as they retain their sharpness much longer than high-speed steel tools and, more important still, the cutting rate can in certain instances be increased up to some ten times the previous figure. To obtain the full output of which these tools are capable, the machine itself must be of extremely rigid construction and specially designed for running at greatly increased speeds. Nevertheless, these tools have their uses in the small workshop, more particularly for machining iron castings and non-ferrous alloys; but they also retain their sharpness for long periods, and impart a good finish to the work when taking light cuts at high speed on mild-steel in the ordinary small lathe.

Machining Cast-iron

Tungsten-carbide tipped tools are always regarded as being rather brittle and not capable of withstanding shock. However, we have not so far experienced any fracture of the cutting edge when machining iron castings either in the lathe or in the shaping machine. For this kind of work, the carbide tool has two great advantages, for, in the first place, it seems to be but little affected by surface sand or scale, and there is, therefore, no necessity to take the first cut deep enough to reach sound metal in all parts of the machined surface.

This is a problem that constantly arises when machining irregular castings, for it may be necessary to take a cut of $\frac{1}{8}$ in. depth, or so, in order to clean up the entire surface. This, however, may be more than the machine can tackle and, as a result, an ordinary tool is quickly blunted by the surface scale where a cut of less than the full depth is taken.

The second advantage is that, for machining iron castings, the surface speed can be increased to some 500 ft. a minute without damaging the tool's cutting edge. This means that a chuck backplate, for example, 4 in. in diameter can be turned when running at 500 r.p.m., and the direct drive of the lathe mandrel can be used instead of the backgear. Cast-iron turned in this way is left with a fine silvery finish, quite different from the dull, mottled appearance obtained with an ordinary tool when the backgear is engaged. In the same way, a 9 in. diameter faceplate can be machined by using a direct drive that does not exceed 200 r.p.m. The tool mainly used in the workshop for machining cast-iron in both the lathe and the shaping machine was obtained from Messrs. Firth Brown, and is their Mitia Grade A product. The tip angles of this tool are shown in Fig. 1B.

Lathe change wheels are sometimes supplied rather roughly machined on the side faces, but a light, finishing cut, taken at high speed with a carbide tool, will greatly improve the appearance.

Machining Steel

Tungsten-carbide unfortunately has an affinity for steel and, as a result, the upper surface of the tool where the chip strikes may become pitted; when, in this way, a crater is formed immediately behind the

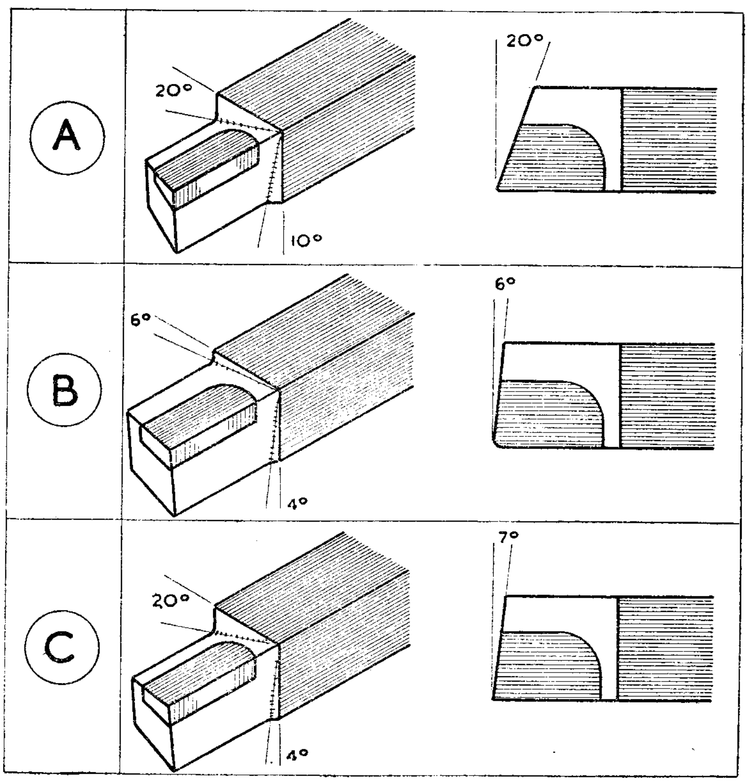


Fig. 1. A—the original Widia tool; B—Grade A Mitia tool for machining cast-iron; C—Grade B Mitia tool for use on steel

cutting edge, the edge itself is in time liable to break off. Various additives have been incorporated in the tip material and numerous alloys tried with a view to overcoming this failing, and when ordering tools, it is best to inform the manufacturers of the machining conditions and leave to them the selection of the correct tip material.

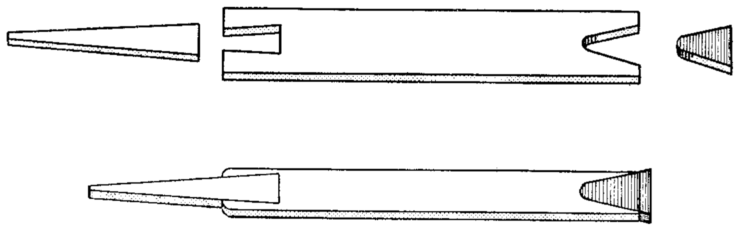


Fig. 2. Stages in making a carbide-tipped scraper

Our first experience with tipped tools was in the early nineteen-thirties, when a friend gave us a tool tipped with the improved form of Widia material manufactured by Krupps of Essen. This tool, illustrated in Fig. 1A, has outstanding properties and, no doubt, this material played its part in speeding up rearmament. For ten years, the tool was used for much of the general turning in the workshop, and at the end of that time, it seemed to have lost none of its original sharpness, nor were the cutting faces in any way marked or pitted. Apart from the routine machining of mild-steel, the tool was used for turning hardened steel ball-races, and for reducing the diameter of hardened tool shanks. Duralumin and bronze could be turned to a high finish, and there was no balling up of the material on the tool point. After the war, we confidentially approached a manufacturer of tipped tools and stated the machining conditions, which amounted to taking medium and finishing cuts on mild-steel at ordinary turning speeds in a small lathe. The tool supplied became markedly cratered after taking two cuts along a mild-steel bar 6 in. in length. The tool obtained from a second manufacturer stood up to an hour's machining before cratering became noticeable. However, for the past three years, a Mitia Grade B tool supplied by Messrs. Firth Brown, and illustrated in Fig. 1C, has been in use in the workshop and has given satisfactory results but the upper surface has to be ground from time to time to keep it free from pitting.

A friend recently obtained for us some tools of the Komet brand manufactured in Berlin, but although these did not crater when turning steel, they were found to be too brittle for machining irregular work in the shaping machine.

Since these notes were written, we have had the opportunity of learning the experiences of a senior executive official and the toolroom foreman of one of our largest engineering works.

Curiously enough, the tale they had to tell with regard to tungsten-carbide tools tallied almost exactly with our own experiences in the more modest small workshop. Some years before the recent war, samples of the Krupp's products had given remarkable results when used for machining steel, but none of this

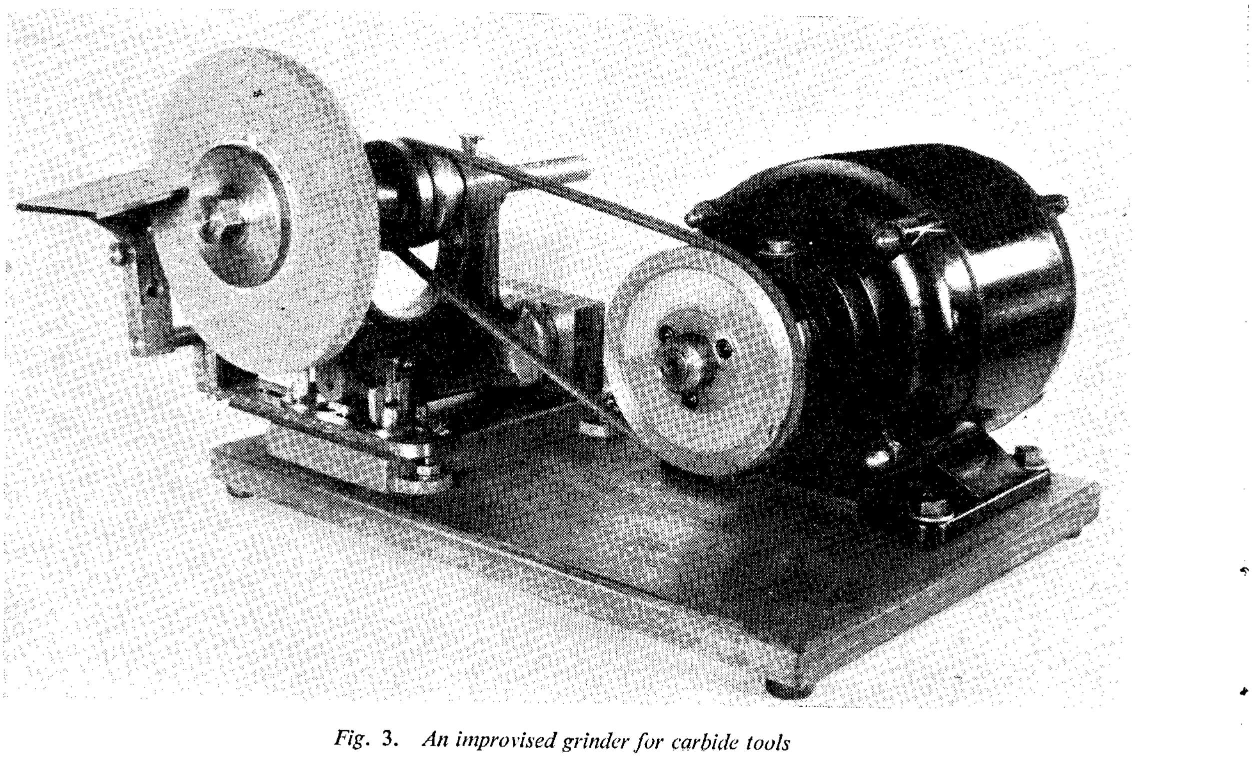


Fig. 3. An improvised grinder for carbide tools

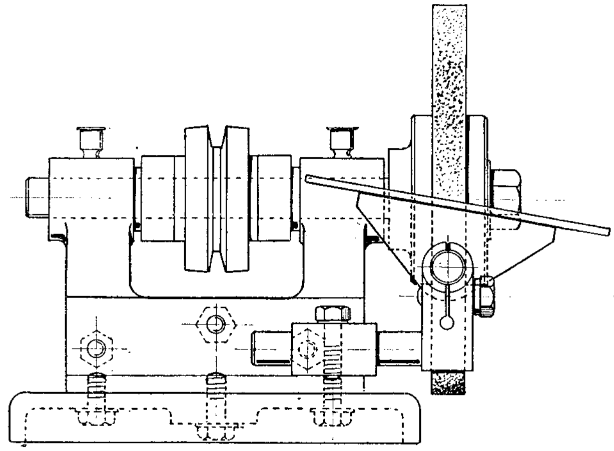


Fig. 5. A grinding head suitable for sharpening tungsten-carbide tools

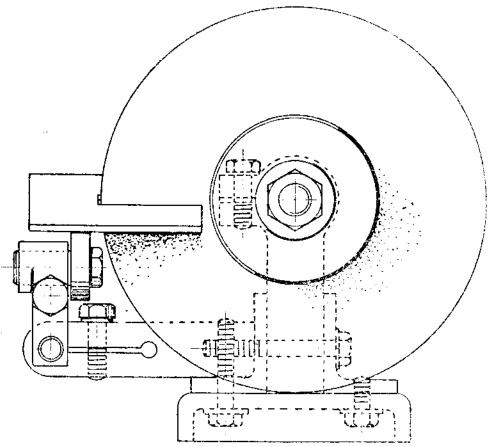


Fig. 6. An end view of the grinder

material now remained. More recently, a large number of substitutes, obtained from various sources, had been tried in the machine shops, but none was found to stand up satisfactorily to the wide range of machining operations on steel, and they were now confined almost entirely to machining cast-iron parts and non-ferrous materials, with excellent results.

However, we learnt with interest that a new tip material, known as Edibrac, was on trial in the shops and, so far, it had been found satisfactory for machining steel. From what has already been written, it will be clear that, for machining steel under ordinary workshop conditions, tungsten-carbide tools have few advantages over those made of high-speed steel. No doubt, some readers will have had greater experience than ourselves, and we would be glad to hear what results they have obtained with carbide tipped tools used on steel.

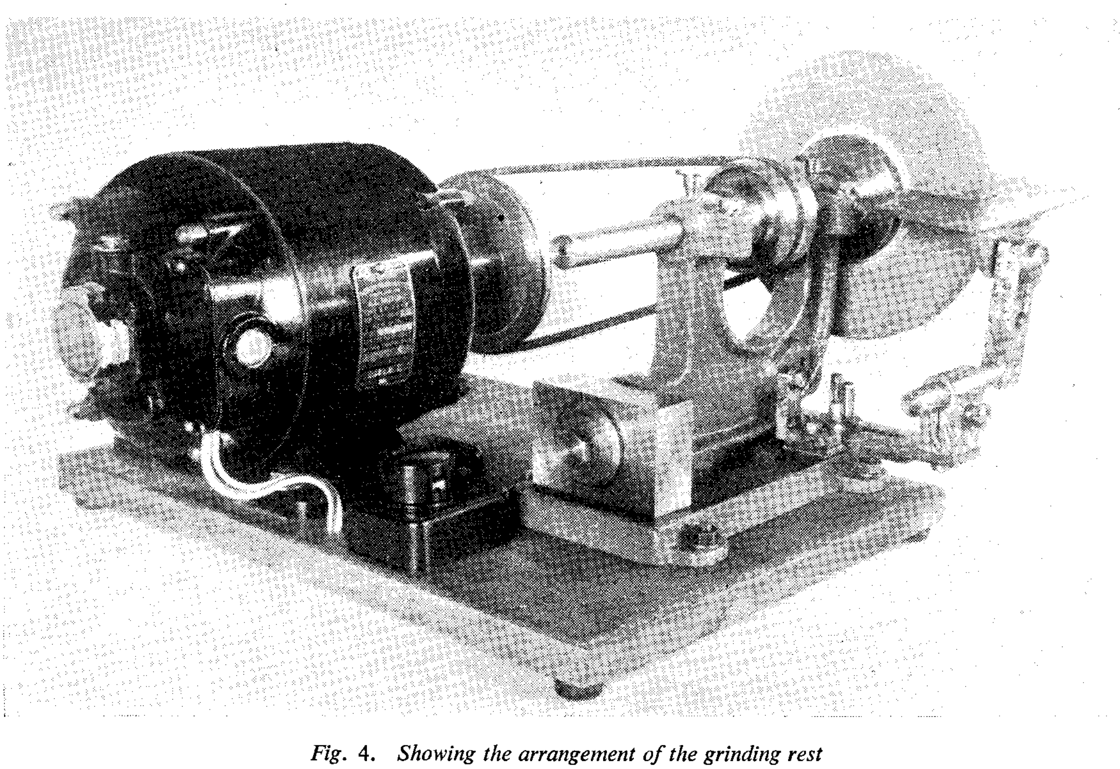


Fig. 4. Showing the arrangement of the grinding rest

Tungsten-Carbide Tipped Scrapers

Those who have had to scrape castings of some of the newer and harder iron alloys will probably have found that an ordinary carbon-steel scraper, made from a discarded file, quickly becomes blunted; in fact, when finish scraping a drilling machine table recently, the scraper had to be resharpened after every second passage across a 6 in. square casting. As the edge of the scraper becomes dulled, the cutting pressure has to be increased, and this adversely affects the finish obtained. On the other hand, a scraper consisting of a carbide tip brazed on to a mild-steel, handled shank will remain sharp and free-cutting for long periods. Although the tip illustrated in Fig. 2 is intended to serve as a lathe tool, it can readily be attached to a steel shank by forming the seating to shape and then brazing the tip in place with Easyflo silver-solder. But care must be taken both

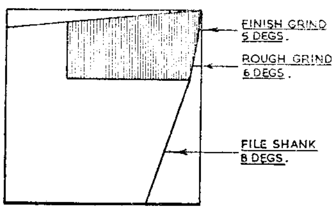


Fig. 7. Showing the three facets forming the side clearance given to a knife tool

to heat and to cool the tip slowly in order to avoid cracking the material.

Although the tip material is somewhat brittle, and is apt to crumble under excessive pressure, the cutting edge is, here, well supported, as the cutting angle can be made equal to a right-angle, and the form of the tip is then equivalent to a lathe tool having some negative rake, and capable of standing up to heavy cutting pressure. The disadvantage of this form of scraper is that in the small workshop there may be no means of resharpening the tool and maintaining a keen cutting edge. However, this problem can be solved without any great difficulty. It should, perhaps, be pointed out that scrapers of this kind are best used for removing the bulk of excess material and, to obtain a fine surface finish, it is advisable to rely on the ordinary carbon-steel scraper, which can readily be given a keen, smooth cutting edge when sharpened on an oilstone.

Sharpening Tungsten-Carbide Tools

As will be evident from its wear-resisting properties, tungsten-carbide is extremely hard and cannot be ground as easily as high-speed steel. Moreover, this material is more brittle than alloy steel and the tool's cutting edge is liable to crumble and chip during grinding.

Commercially, carbide tools are ground on wheels impregnated with diamond dust, and both a roughing and a finishing process are necessary to produce a satisfactory edge. However, these wheels are very costly, and are usually beyond the means of the small workshop, where the carbide tools may need sharpening only at long intervals. The ordinary grinding wheels, embodying an aluminium oxide abrasive, will not serve for sharpening carbide tools and, instead, the much harder silicon carbide is used in the so-called green-grit wheels, which are comparatively cheap, but cut much more slowly than the diamond variety. For the initial roughing grind, a wheel having a grit size of from 46 to 60 will serve, and the manufacturers recommend a vitrified bonding of medium hardness.

The 6 in. diameter wheel we use for this purpose, was obtained from the Universal Grinding Wheel Co., of Stafford, and is designated C60JV; this means that *C* the abrasive is of silicon carbide, the grain size is 60, the bond *J* is of medium hardness and *V* is of the vitrified type. Before dealing with the equipment for finish grinding, which will form the subject of a second article, it may be as well to describe the rough-grinding process in further detail.

An Improvised Grinding Head

Rather than keep changing the wheels on the workshop grinder, it was decided to build a machine with self-contained drive for rough-grinding carbide tools. This machine, illustrated in Figs. 3 and 4, was built from material that happened to be available at the time, and the body and base are drilling machine castings. It is important that the machine should be made as compact and rigid as possible, in order to avoid vibration when running, as this is liable to cause crumbling of the ground edge. The grinding head illustrated carries a single wheel only, as this is all that is necessary for rough grinding, but a suitable wheel could, of course, be mounted on the other end of the spindle to serve for finish grinding. As will be seen, the tool rest fitted is fully adjustable for angular grinding.

In Figs. 5 and 6, the same type of grinding head is shown built from castings designed for the purpose.

The tip angles specified in manufacturers' catalogues are intended to impart the maximum strength to the cutting edges, consistent with free-cutting. Demonstrations of the capabilities of these tools can be seen at engineering exhibitions where, it may be, a locomotive wheel is being turned at high speed to form the tread seating, and the thick shavings come off at a blue-heat.

In the small workshop, however, turning feats of this kind are not called for, and the rake and clearance angles of the tools can be increased without danger of breakages provided that the tool is not subjected to excessive shock when machining irregular work. Before starting to grind the tool, examine the tip to make sure that the shank is cut back to a greater angle than that of the carbide material; otherwise, the soft steel will load and clog the grinding wheel. There is no need to follow the advice, so often seen in print, that a special wheel should be used for grinding the shank clearances; an old file will serve perfectly well for this purpose. The upper surface of the tool should be ground first, and the wheel must then rotate towards the cutting edge with the rest set at the appropriate angle.

Care must be taken not to overheat the tip, as this may cause cracks to form. On no account cool the tool by dipping it in water. After the front and side clearance angles have been ground, the tool should be examined with a hand-glass to see if there is any irregularity or crumbling of the cutting edges; this can often be corrected by pressing the tool very lightly against the wheel at a second attempt. Nevertheless, we have found that tools left with a somewhat imperfect edge after rough grinding seem to cut quite well, but an irregular edge tends to crumble and does not last as long as one ground to a smooth finish.

The front view of a knife tool, represented diagrammatically in Fig. 7, shows how the side face is composed of three different angles. The upper facet is formed by finish-grinding and this operation will be dealt with in a subsequent article, where making a small grinding head with an adjustable tool rest will also be described. For, apart from regrinding a broken tool, a machine of this kind will serve for the routine sharpening of carbide tools in the workshop.

L.B.S.C.'s "NETTA"

A NORTH-EASTERN T-CLASS "MITEY" HAULER IN FIVE GAUGES

REGULAR readers of these notes may recollect that, after being ticked off about neglecting the needs of $2\frac{1}{2}$-in. gauge locomotive-builders, I held a sort of "Gallup poll" to find out what type of engine would prove most acceptable to the majority of our friends; and the engine that "got in," was the old North Eastern Railway's T-class 0-8-0. No sooner was the result of the election announced, than suggestions came in that it wouldn't be a bad wheeze to include dimensions for other gauges as well. Now, I'm only a human being, with physical limitations regarding "output"; and what with the *Britannia* serial, and other commitments, it was an impossibility to make any drawings of a new engine at the time. As soon as I got a "yellow light" (didn't wait for a green one !) I managed to make a start on the doings, and now have great pleasure in offering it to all concerned, by kind approval of our friend the K.B.P. I've a sneaking suspicion that he wishes it were G.W.R.; anyway, it has a polished chimney top and a brass safety-valve casing, and that will please both of us !

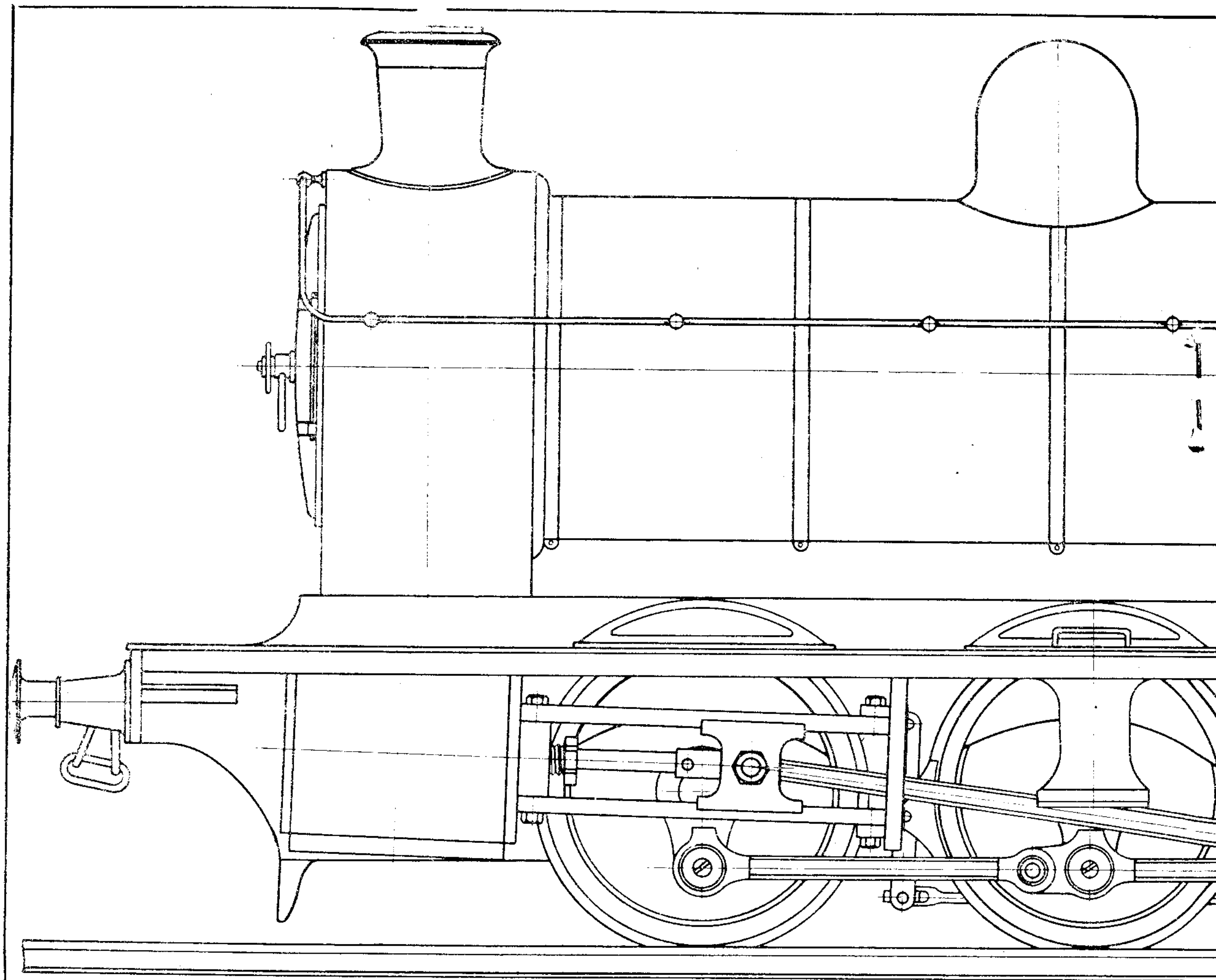
Now in an endeavour to please as many as possible of the lads of the villages, I'm going to attempt something that I've never done before, viz. give sufficient drawings and information, including full details of valve-gears, for building the locomotive in *five sizes*. Originally, I schemed it out as a $2\frac{1}{2}$-in. gauge job; then thought that as so many are now building to $3\frac{1}{2}$-in. gauge, the details for that size might as well be included. As it is easier for me to draw a $3\frac{1}{2}$ in. gauge engine than a smaller one, I drew out the general arrangement full size for $3\frac{1}{2}$-in. gauge. Then I had a brainwave ! Although there are nothing nearly so many gauge "1" railway owners as the larger sizes, I get plenty of requests to bear their requirements in mind; also I still am asked to remember gauge "O." Then there are the few with heavy pockets, expensive equipment, and Rolls-Royces and Bentleys, who can tackle 5-in. jobs without "feeling a draught." Why not try and satisfy the blessed lot ? There was my pretty picture in $3\frac{1}{2}$-in. gauge; I also had the "development drawing," as Crewe would call it, of the $2\frac{1}{2}$-in. job, with all the sizes on it. Half of $3\frac{1}{2}$-in. works out at $1\frac{3}{4}$ in.; at least, it did when I went to school ! Half of $2\frac{1}{2}$ in. is $1\frac{1}{4}$ in. which gives us gauge "O," and twice $2\frac{1}{2}$ in. gives us 5 in., completing the whole range; and I figured that by using the two drawings first mentioned, and supplementing them with separate details where such would be advisable, any locomotive builder with the average amount of gumption, would be able to build whatever size of engine that he fancied. Well, we'll see how it pans out.

An Ideal Job

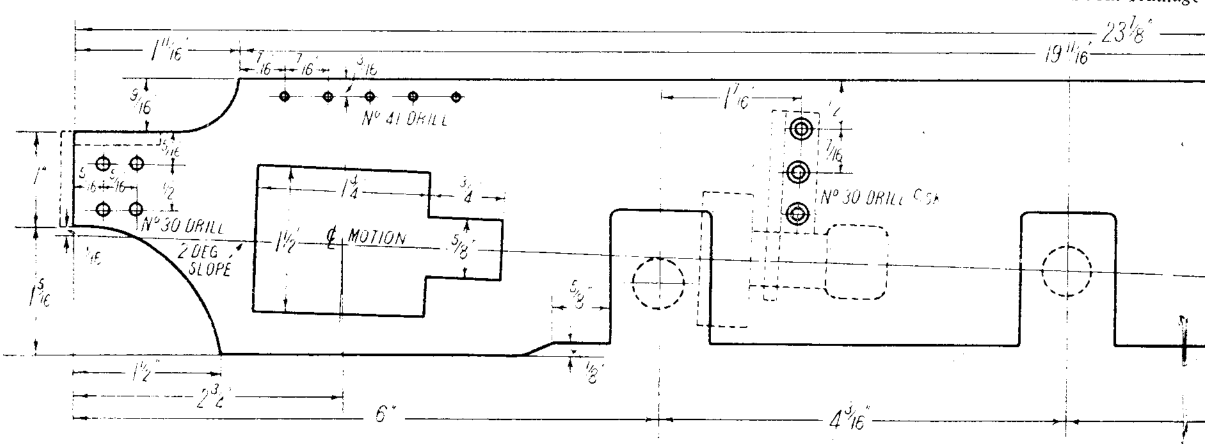
Netta—(N.E., T-class; what else *could* I have called her ?) is an ideal job for any locomotive-builder who needs a simply-built, sturdy and efficient engine which packs the maximum of power into the minimum of space. She is the cat's whiskers for the average suburban back-garden, which is usually only long enough to accommodate an up-and-down straight line. The whole of the weight being available for adhesion, the big cylinders, small wheels, and ample boiler power, all combine to give the acceleration needed, to get any pleasure out of what really amounts to a shunting job. Same applies to the straight portable lines used by the fraternity who go visiting fetes and other similar functions; the power available is also just right for hauling big loads of kiddies. The engine will also negotiate any usual curve with the same facility as a 4-6-0 of contemporary size, the fixed wheelbase of which is about the same. In the tiny sizes, the engine will not only haul a very long train of wagons on a "scenic" line, but can be made to traverse quite sharp curves by turning off the flanges of the second or third pair of wheels; whilst the big boiler allows of a long non-stop run without attention.

The construction work is also ideal for a beginner. The frames are practically straight lines, and could be cut out in the smaller sizes, in a single evening. The buffer and drag beams are simple bits of angle, though I expect that our enterprising approved advertisers will supply castings with the fixing lugs cast on, thus saving work. The cylinders are easily machined, and attached to the frames by flanges at top and bottom, the holes in the frame accurately locating them. The guide-bars are just straight bits of rectangular steel, with the simplest type of crosshead used in full size. In the three larger sizes, the valve-gear is Stephenson link motion, which can be made very strong without being unsightly, as it is between the frames. In the two smaller sizes, I recommend loose-eccentric gear, where the engine is used for continuous running on a "scenic" line. The axles of these can run in plain bushes, saving more work without affecting efficiency.

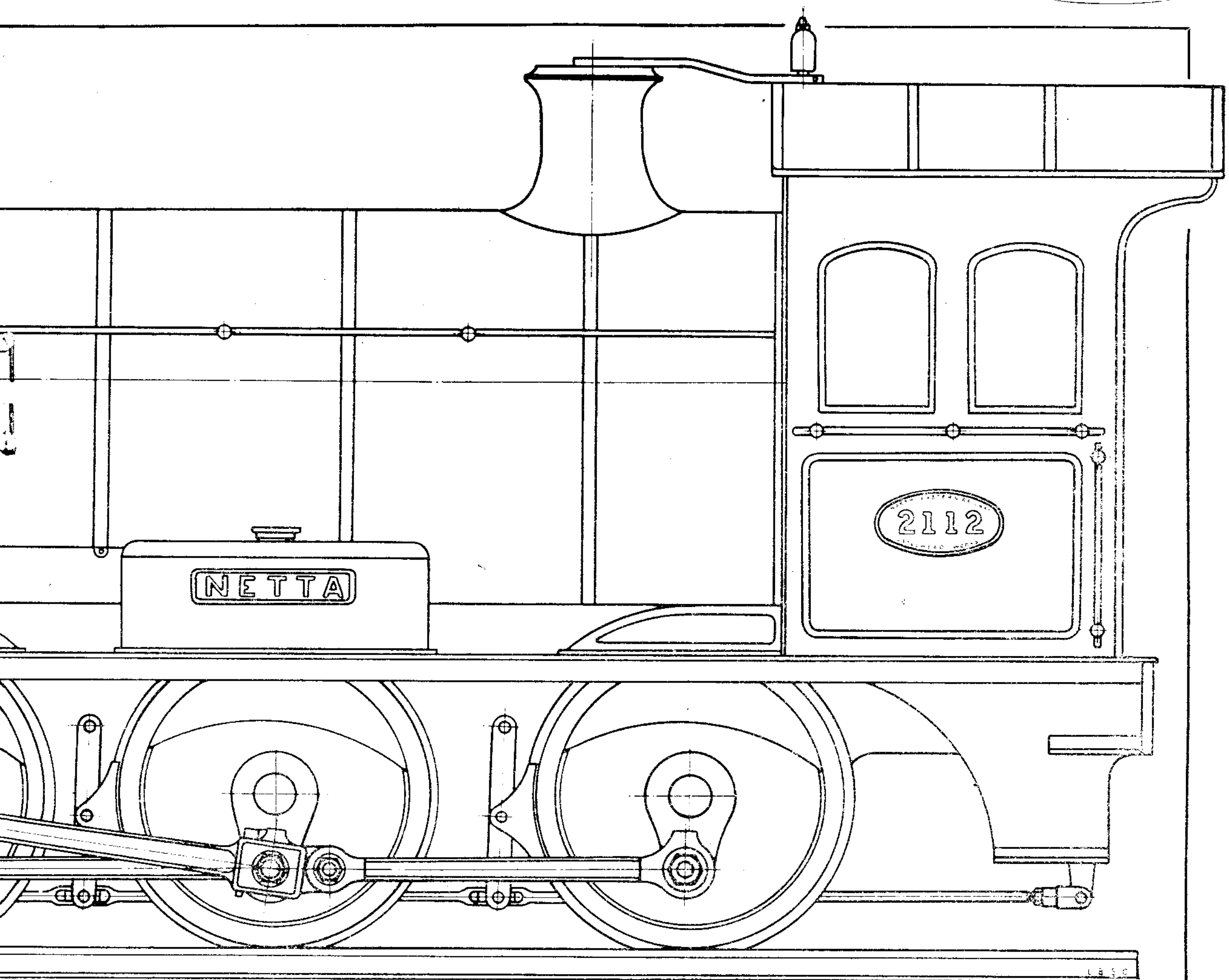
The three larger sizes have, of course, coal-fired locomotive-type boilers of my usual quick-steaming pattern, the construction being simple, easily carried out by any worker with the average amount of skill and equipment. No "fancy" designs are needed. The smaller ones are of the water-tube type, and may be fired either by spirit, or by small vaporising oil burners. The bigger boilers are fed by pump and injector, with a tender hand-pump as an emergency stand-by; the $1\frac{3}{4}$ in. gauge boiler can have a pump driven by an eccentric, if desired, but this isn't necessary for the average length of non-stop run It takes a minute or so, at most, to put enough water in, with the tender pump, for another spell of running. I might mention that it was rather a ticklish job to find a satisfactory place for the eccentric-driven pump. It couldn't be put in the usual place between the driving axle and the one immediately in front, owing to the inside valve-gear; and as the eccentric-rods pass over and under that axle, and the expansion links occupy the space just ahead of it, that place was also not available. The problem was solved by placing the pump close to the leading axle,



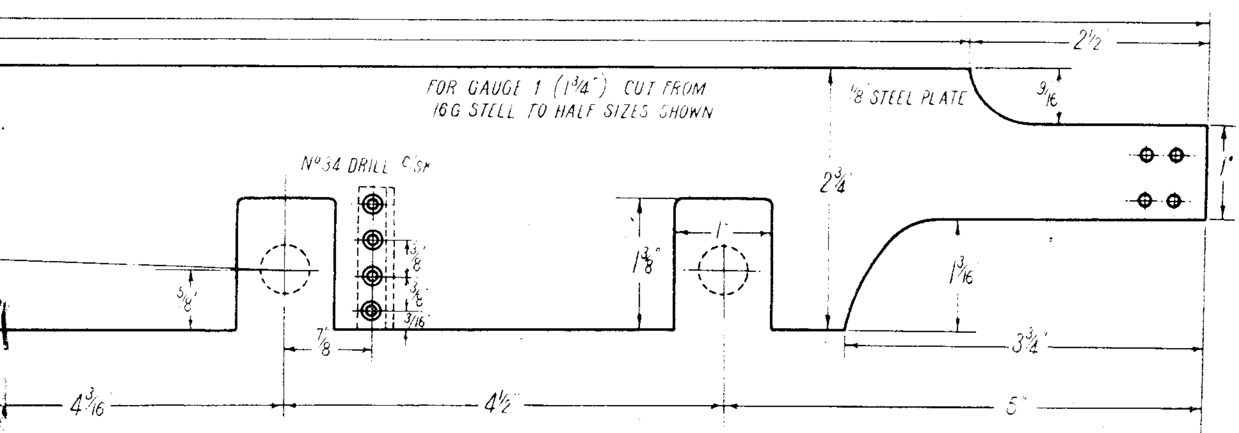
A real Haulage



Frames—dimensioned for



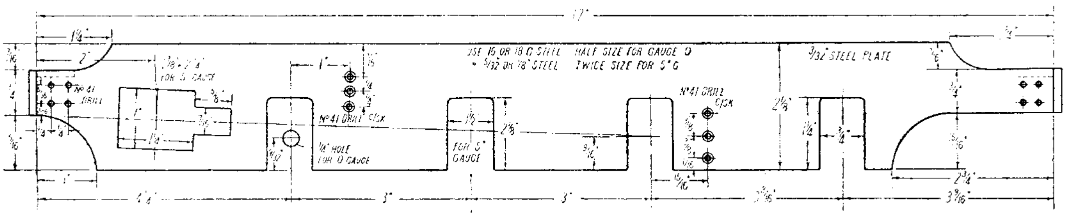
ge Contractor !



or the 3½-in. gauge engine

on the centre-line of motion, the barrel coming below the stay which carries the pump; and incidentally it's an ill wind that blows no good, as that location of the pump-stay allows it to act as support for the valve spindles, as you'll see when we get that far. It also makes possible, a long pump-eccentric rod, which avoids excessive angularity on top and bottom centres, and reduces gland wear. The rod will have to be set, to clear the intermediate mark it off from the centre-line of motion, which has a 2-deg. slope on all five engines. There is no need to bother about setting this with a protractor; just mark the position of the driving-axle in its running position, as shown, $\frac{5}{8}$ in. from the bottom of the frame, in the centre of the third hornblock opening. Draw a line from this, cutting the front of frame at $\frac{1}{16}$ in. below the location of the buffer beam and Bob's your uncle. The the steam-chests of the cylinders specified for the outside-cylinder version of the same type of locomotive.

For a gauge "O" job, the frames can be cut to half-size, from 16-gauge or 18-gauge metal; instead of cutting hornblock openings, follow the instructions for the gauge "1" frames, fitting bushes with $\frac{3}{16}$-in. holes in them, into $\frac{1}{4}$-in. holes drilled in frames at the wheel centre location. The wheelbase should be



Frame plates for the $2\frac{1}{2}$-in. gauge engine

axle; but that is a matter of no consequence, as the valve eccentric-rods are also set over, same as on the full-sized engines.

There is nothing difficult about the superstructure; straight-line running-boards, and a simple cab—nothing like the elaborate trimmings on *Britannia*! The tender is also a simple job, too; just the ordinary type of six-wheeler, without any curved sides, hopper, or other "modern improvements." A study of the general arrangement drawing, will show that there is nothing to offend the eye of our old friend Inspector Meticulous, although the details will be designed, as usual, to suit the size of the engine. I guess that is all there is to be said about the job in general, so let's get on with the business. To save time, space, and unnecessary drawing, I'll concentrate the principal instructions on the $3\frac{1}{2}$-in. and $2\frac{1}{2}$-in. gauge sizes, and bring in the others where there is any radical difference in proportionate dimensions, or in the actual construction. Separate drawings will, of course, be given where necessary, so I hope everybody will be happy. Blueprints will be available from our offices, as soon as my original drawings can be traced.

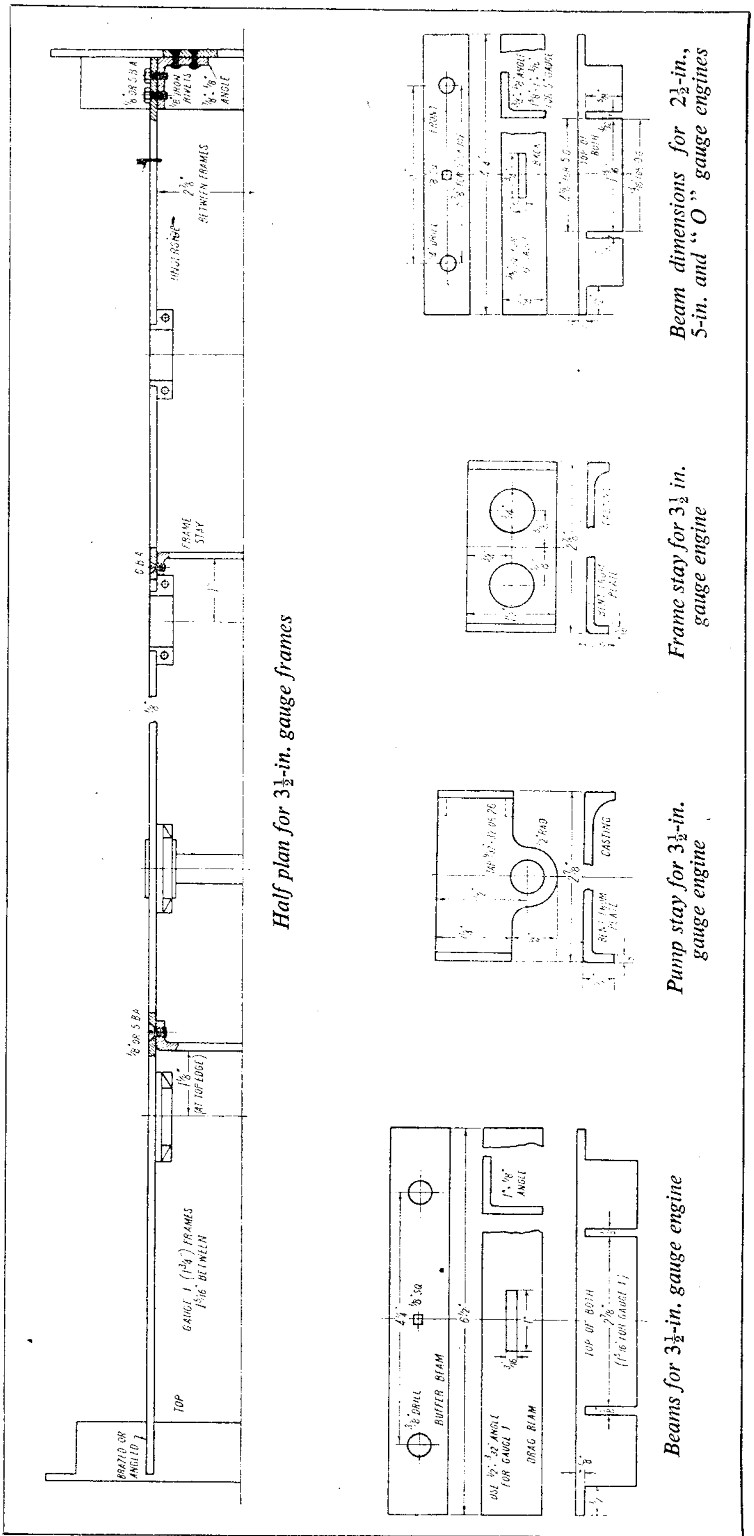
The frames for a $3\frac{1}{2}$-in. gauge *Netta* will need two pieces of $\frac{1}{8}$ in. soft mild-steel, blue or bright, approximately 24 in. long and 3 in. wide. Mark one out, as shown on the accompanying drawing, rivet the two temporarily together, and saw and file to outline. Take care to have the hole for the cylinder steam-chest in the right postion; centre of the cylinder opening is $2\frac{3}{4}$ in. from the front edge of the frame. The location of all the screw holes can easily be seen; the position of the pump and frame stays, are shown dotted. Leave the tops of the hornblock openings slightly rounded, as shown; an Abrafile, or Tyler spiral blade, will cut them out in two wags of a dog's tail, if properly handled.

Frames for a gauge "1" engine are cut from $\frac{1}{16}$-in. steel, to half the dimensions shown; but the hornblock openings need only be cut out, if sprung axleboxes are needed. For "scenic" lines, the axles can run in plain bushes. At $\frac{5}{16}$ in. from the bottom of the frame, at the spacing indicated by the centre-lines of the horn slots (half the dimensions shown) drill $\frac{3}{8}$ in. holes, and fit bronze or gunmetal bushes in them, with $\frac{1}{4}$ in. reamed holes, and $\frac{1}{16}$-in. flanges on the outside. A drawing of these will be included with gauge "1" details.

A fully-dimensioned drawing is given for the $2\frac{1}{2}$-in. gauge frames, and the same remarks apply, as given above. Separate drawings of the hornblocks and axleboxes, for both sizes, will appear in the next instalment, if all's well. For a 5-in. gauge engine, double the $2\frac{1}{2}$-in. gauge dimensions, and use 5/32-in. plate if available; failing that, $\frac{1}{8}$-in. plate can be used. Note that the height of the hornblock opening should be $2\frac{1}{8}$ in. only, which will allow the same type of hornblock casting, as fitted to *Maid of Kent*, to be used. Also note the opening for cylinders; this is $2\frac{3}{4}$ in. long, and $1\frac{7}{8}$ in. deep, which will accommodate set out to half the $2\frac{1}{2}$-in. gauge dimensions. All the frame plates, in all five sizes, are plain straightforward jobs, and I don't anticipate that any follower of these notes will have the slightest difficulty in cutting them out. Careful sawing and filing, is all that will be necessary; but of course, any lucky owner of a milling-machine won't need to bother with hand-filing! I cut the frame plates of my L.B. & S.C.R. *Grosvenor* on my milling-machine, as a variation from using the little Jerry oxygen cutter.

Buffer and Drag Beams

The only difference between the buffer and drag beams, is that the former has holes for the buffer-socket spigots, and the spring draw-bar, and the latter has just a slot for the coupling-bar between engine and tender. The sizes for the $3\frac{1}{2}$-in. and $2\frac{1}{2}$-in. beams are given in the drawings, which show the beams made from ordinary commercial steel angle; bright quality should be used if available, but black will do, though it will probable need smoothing on the flat faces. The gauge "1" beams can be made from either steel or brass angle, to half the $3\frac{1}{2}$-in. gauge sizes, the slots for the frames being cut $1\frac{5}{16}$ in. apart, and $\frac{1}{16}$ in. wide. The gauge "O" beams are best made from $\frac{3}{8}$-in. square rod, with slots cut to suit the thickness of frames, the latter being brazed into the slots. I used this type of beam on the original *Sir Morris de Cowley*, and they are still O.K. On the 5-in. gauge engine, the beams are made from heavy angle, $1\frac{5}{8}$ in. $\times$ 1 in. $\times$ $\frac{5}{16}$ in.



Half plan for 3½-in. gauge frames

Beam dimensions for 2½-in., 5-in. and "O" gauge engines

Frame stay for 3½ in. gauge engine

Pump stay for 3½-in. gauge engine

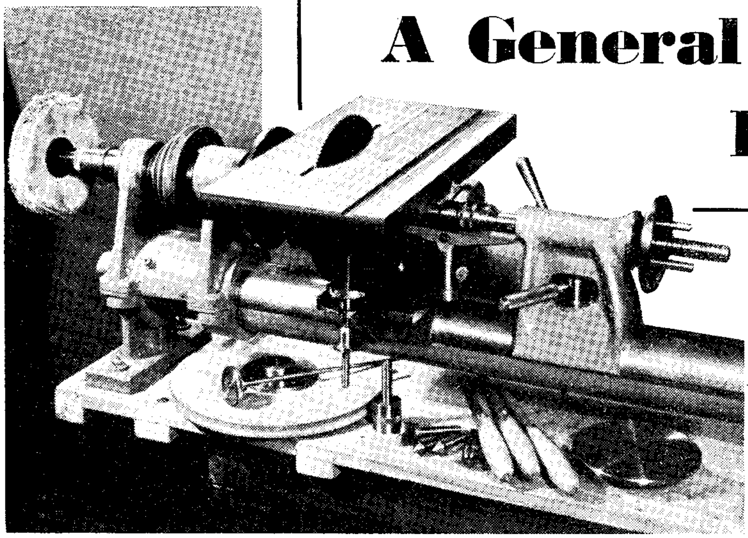
Beams for 3½-in. gauge engine

The slots for the frames are cut in the narrower member, and are set at 4⅛ in. apart. This is my "standard" spacing for this size locomotive.

The half plan of frames shows two methods of erection. One is to rivet pieces of angle to the inner sides of the slots for the frames in the top of the beam; and after truing up the assembly on the lathe bed, or any other available flat surface, the frames are screwed to the angles as shown. I have described this process in full detail, goodness knows how many times, so needn't dilate on it here. It is important that the frames should be a good fit in the slots in the top of the beam, to ensure perfect alignment.

The other method is the one I usually employ myself, viz, to braze the whole blessed lot up solid. It is quick, certain, and strong! The only precaution is that the frames must be held very tightly in position, because metal, when heated, expands (which is one reason why I always recommend that boiler joints should be temporarily fixed with a few rivets before commencing brazing operations) and if not secured, the frames would go "all over the shop" as soon as the blowpipe or lamp got really busy. I have already described, at some length, how I clamp the frames together with a distance-piece between them, and a hefty cramp over the outside; and as I use an oxy-acetylene blowpipe and Sifbronze, I don't have any trouble with frames warping. In the present case, if the pump and rear frame stays are made and fitted before the brazing job is started, they should hold the whole bag of tricks in good alignment, while it is carried out.

The pump stay, and the rear stay, for the 3½-in. gauge engine, are both shown in the accompanying illustrations, and may either be bent up from ⅛ in. steel plate, or castings may be used. If bent, and you haven't a proper bending-brake (very few of these seem to be found in home workshops), the bench vice can be used, but hold the longer part of the stay (the centre section) between the vice-jaws, and knock over the flange to right angles, with a fairly heavy hammer. Alternatively, instead of bending the flanges, separate flanges of commercial angle may be riveted at each side of a flat piece of plate, cut to shape and size shown, to fit between the frames. Castings can be milled on both edges, by clamping under the slide-rest tool-holder, packed up to centre-height, and traversed across an end-mill or slot-drill held in the three-jaw.



A General Purpose Lathe

By A.M.I.P.E

AFTER a long experience as a practical engineer and woodworker, the writer at 50 years of age, decided that the modest workshop he had, containing a bench and handtools was not enough. Looking to the future and time of retirement he began to consider the building up of a really *useful* home workshop. The following machines were considered necessary to the particular type of work he does: a multipurpose lathe, a bench-grinder and sander and a high-speed drilling machine.

Further thought convinced me that great pleasure would be afforded by designing and building my own machines and seeing my workshop grow over the course of a few years.

It was decided to build the most useful tool first, namely the lathe, of a type particularly required by the writer. This was discussed (always a good idea) with a draughtsman friend, a keen hobby man, and the general outline and size of machine agreed upon. It would be for wood-turning, plastic and light metal turning, and have the following attachments: circular saw (rise and fall table), buffing wheel, sanding disc and grinding wheel.

With my friend's knowledge of pattern-making, the main castings were drawn out: viz. headstock, tailstock, tool-rest table, saw table and bracket and feet for the bed, also the arrangement of the headstock—spindle and bearings. This was the only drawing used, and it was felt that with my long practical experience and "know how" of engineering, the lesser parts could easily be designed and fitted afterwards. The bed was to be made from $3\frac{1}{2}$ in. bore heavy steam tube.

After deciding centre height $4\frac{1}{16}$ in. for an 8 in. diameter saw, with four speeds ranging from 3,500 down to 600, and size of main spindle, a start was made on the patterns.

With my friend's knowledge of patterns, and my handiness at wood-working, the patterns and core boxes were soon produced. I learnt much from this, and have since produced my own patterns for my second machine, a tool grinder and sander. Castings were kindly made at reasonable cost by a busy local foundry, who were glad to help me.

The steam tube was bought at a local ironmongers, care being taken in selecting a straight piece, to save reducing the diameter too much in machining up.

Machining the Bed

The ends were carefully squared off by filing, spigoted plugs were turned to fit the ends, truly centred, and the tube turned up between centres in a centre lathe. Great care was taken to ensure parallelism. The bed was finally polished with fine emery paper and oil to remove "high" spots, meanwhile carefully checking with a micrometer, the bed being finished to $3\frac{7}{16}$ in. diameter. By overhanging the tailstock of the lathe, a maximum length of forty-two inches of bed was obtained.

Another separate piece of bed 8 in. long was turned exactly the same diameter to use as a plug gauge when machining that portion of the castings that had to be a snug fit to the lathe bed.

A $\frac{3}{8}$ in. wide keyway was then milled right through the thickness of the bed and along its complete *working* length, no keyway being necessary under the headstock.

Headstock

The casting was wedged up on surface plate, chalked and lined out for machining, to keep all boring as central as possible in the casting, as this makes for a neat and finished appearance.

Surplus metal was machined from the base, and front edge and one side of the lower edge of casting "cleaned up" square to each other. This made setting up on the milling machine table, quick and easy to accomplish. The same method of setting out and preparatory machining was used on the tailstock casting.

At this stage, it was realised that certain "tooling up" would be necessary to machine the castings successfully. These tools were made as required and will be mentioned as they were used.

Two parallel strips were made, precision ground, greater in depth than half the diameter of the bed. (See photograph of head being bored on these strips.) This allowed the tool to clear the table of milling machine when boring the half-bore of the headstock and tailstock.

Machining the Headstock

(1) Headstock was set up on these strips clamped down, set square by the edges already machined, and checked with dial indicator from the edge of the milling machine table.

A short stiff boring bar ($\frac{3}{8}$ in. square tool) was made and fitted to the machine head, of a length just to clear the bore of the casting. The half-round bore was then machined out successfully, using the short piece of "prepared bed" as a plug gauge, checking the fit carefully by using "blue marking" to get perfect bedding down.

(2) The boring bar was removed and the table *lowered* exactly 5 25/32 in., using the micrometer index collar on the lowering feedscrew of the machine for accurate measurement, and taking care all "backlash"

was removed before lowering. The head was now ready for boring to take the two front A.C. ball-bearings and the rear roller bearing.

A longer boring bar was now made to fit the milling machine head, the outer end being turned to a bearing fit in the arbor bearing of the machine. This bar had two cutter positions, as now the travel was limited. Thus the bar was rigidly supported at each end, making for accurate and smooth cutting, so essential when using a fairly long and light bar on such an accurate operation.

Tailstock

This, again, was mounted on the parallel strips, squared up and clamped down, taking care to have the hand-wheel end of boss facing the column of the machine to enable the recess for hand-wheel boss to be machined after boring for the spindle.

The same heavy boring bar was used to machine the half-bore of the tailstock. This finished, the table was again lowered the exact amount as before, using the micrometer collar to index the amount exactly to 1/1,000 in. Great care was taken over this operation. I was now ready to bore for the tailstock spindle.

The end of the boss was faced, centre-drilled for an accurate start, and drilled $\frac{13}{16}$ in. diameter right through.

Now a light carbon steel boring bar was made, again to fit the milling machine head, and drilled to take a $\frac{1}{4}$ in. round tool bit. Using a fine feed, and carefully setting the tool by tapping it outwards and checking with a micrometer from the tool point to the underside of the bar, the hole was bored $\frac{7}{8}$ in.—3/1,000 in. The hole was then nicely finished off with a $\frac{7}{8}$ in. parallel reamer smeared with petroleum jelly.

Next a recessing tool was made (Fig. 2) to fit the machine head the plug end X being a running fit in the bore just machined.

Thus rigidly supported and the tool set to the correct diameter, the recess for hand-wheel was quickly cut.

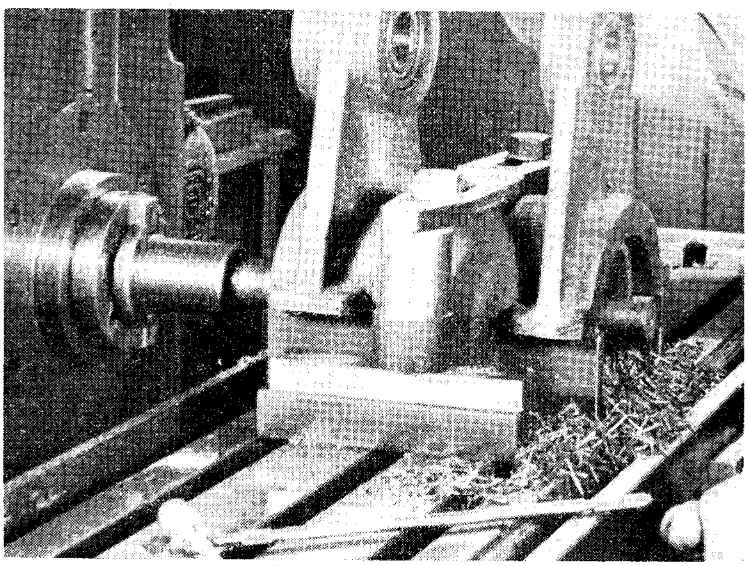
This again completed the tailstock machining, except for drilling and tapping for the split retaining plate, which when made first as one piece, was used as a jig to drill the holes in the correct positions. These plates, of course, hold the hand-wheel in position on the tailstock spindle, and take the thrust of the centre, or when drilling. The casting was also recessed underneath, dead central for the $\frac{3}{8}$ in. hardened key to slide in keyway along the bed.

Table (Tool Rest)

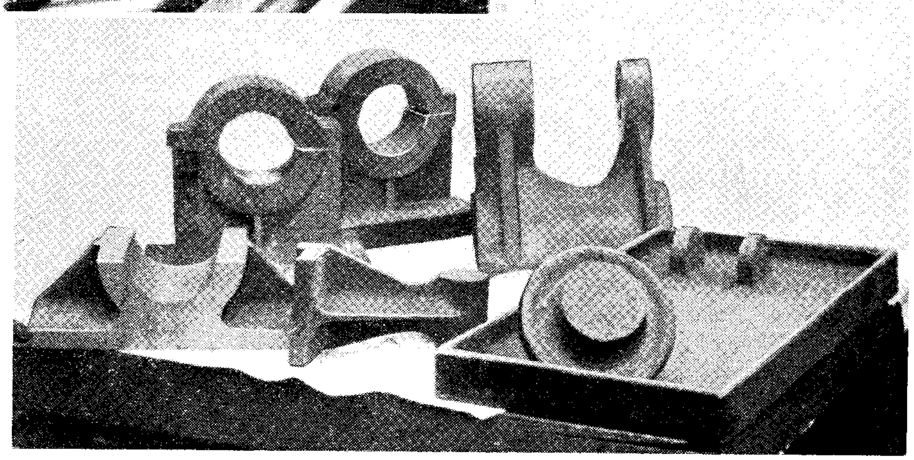
Face of table was machined flat, and edges milled square all round. The casting was then set face down on milling machine, squared with edge of the machine table, and bored to suit lathe bed. Except for recessing underneath for the keyway, and drilling for the clamping bolt, this was now complete.

Feet for Headstock and End of Lathe Bed (2)

Bases and butting faces were machined off, drilled and tapped for $\frac{5}{16}$ in. socket screws, and assembled with 10/1,000 in. shim, then mounted and clamped on the mill-table and both bored at one setting exactly to the diameter of the lathe bed. This worked out



Set up for boring on two parallel strips. Boring bar is shown in lower half of casting. Note, bearings fitted to main spindle housings



Right: Patterns for some of the lathe components

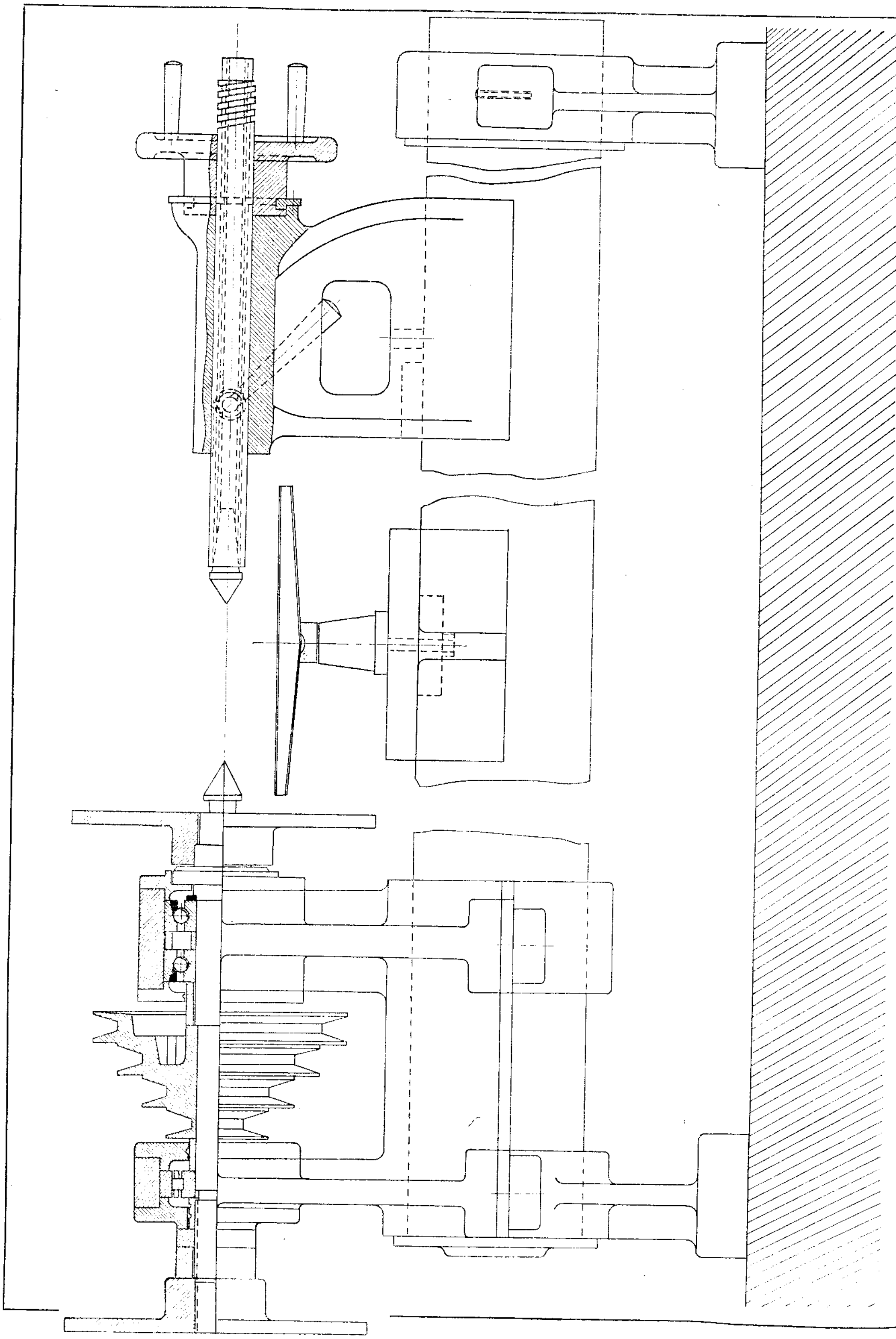


Fig. 1. Part sectional elevation of general purpose lathe

perfectly, since as will be seen in the photograph, the cap of the headstock foot bracket becomes the retaining cap of the front of headstock in the final assembling.

Headstock Spindle

High duty steel was roughed out $\frac{1}{16}$ in. large all over, and to various shoulder lengths, ends then finished and screwed 10 t.p.i., 1 in. diameter front end, 12 t.p.i., $\frac{7}{8}$ in. diameter left-hand at the rear end of spindle. The body was then machined 15/1,000 in. up on the bearing sizes, and finally finished to size a push fit in the bearings on a precision grinder. At this stage the spindle was left.

Faceplates

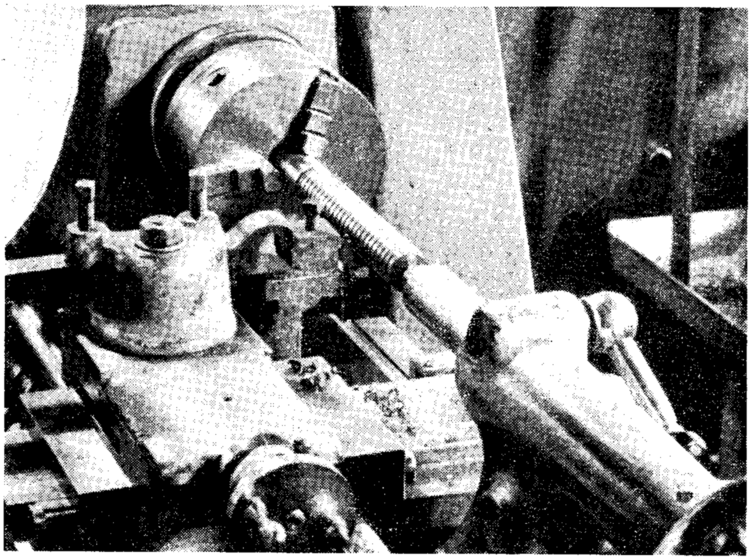
These were prepared from $\frac{3}{8}$ in. steel plate, bosses spigoted, pinned and then brazed up. They were then chucked in lathe, boss outward, faced, bored and screwed to fit respective ends of headstock spindle. Now each was mounted in turn on the headstock spindle, and using this as a mandrel between centres, each plate was machined all over, dead true, and polished. Using the index collar on the lathe and a sharp pointed tool, concentric circles were cut lightly on each plate. Using a height gauge, lines intersecting the centres, and at right-angles were marked across the plates. This made the plates easy to mark out and drill for the work fixing holes; finally backs of drilled holes were countersunk for wood screws.

Tailstock Spindle

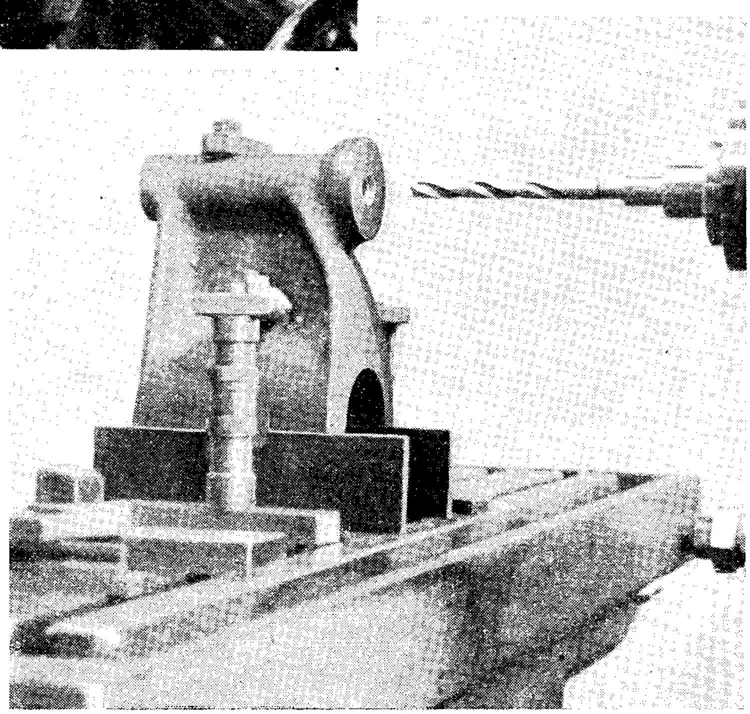
This was turned from mild-steel between centres leaving 15/1,000 in. for ground finish to size, then ground to a plug fit in barrel of tailstock, returned to centre lathe, and screwed the correct distance five square threads per inch. It was then set truly in the chuck, and other end in a steady, and drilled right through the whole length. Front end was then bored Morse taper and finished lightly with a standard M.T. reamer.

Now, with the same set-up, the main headstock spindle was drilled and bored Morse taper. A $\frac{1}{4}$ in. keyway was then milled through the length of the unscrewed portion of the tailstock spindle, to accommodate the small key and locking screw of tailstock.

(To be continued)



Tailstock spindle operation—screwing five square threads per in. Note the goose-neck spring tool holder, for sure, clean cutting



Right: Preliminary drilling of tailstock bore

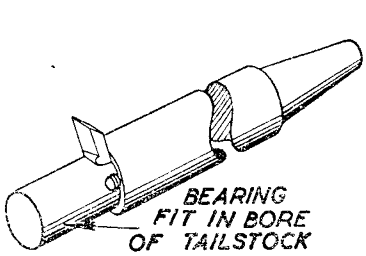
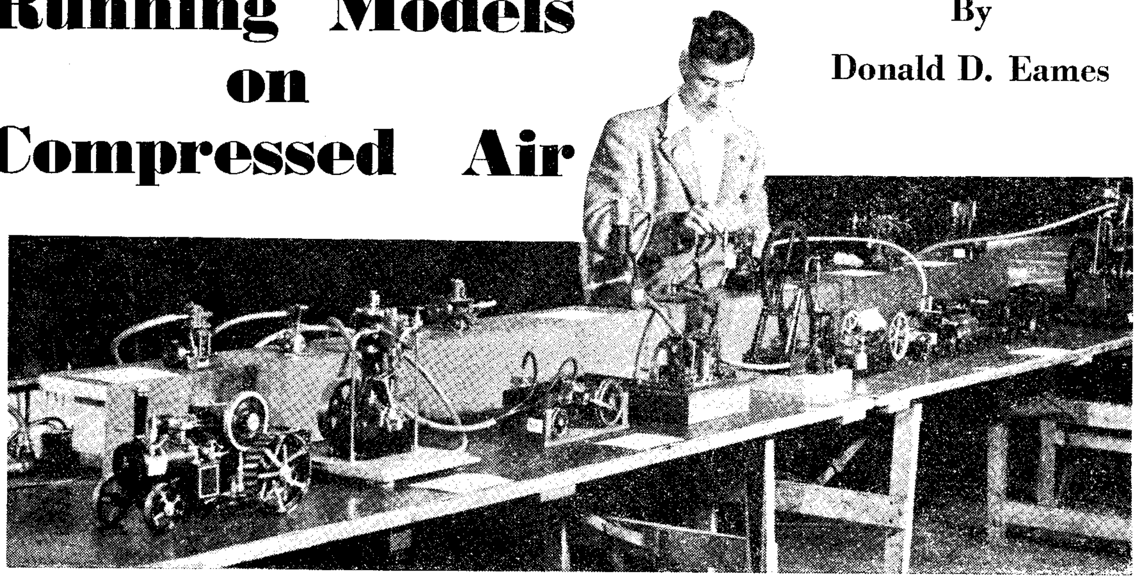


Fig. 2. The recessing tool for tailstock casting

Running Models on Compressed Air

By

Donald D. Eames



The writer oiling up before the start of a day's running

ONE of the most important sections at a model engineering exhibition, in the writer's opinion, is the running of steam models by compressed air. Whereas a static model may cause only a casual glance from members of the lay public, the same model in motion can have intense interest. It has been noticed at many exhibitions that this section has either been omitted, or spoilt by bunched exhibits and high running speeds. It is extremely important, and this applies also to other exhibits, for the public to be kept slowly on the move, examining one exhibit after the other. This, of course, is impossible when models are bunched together. There is always a knot of spectators, and a lot of people do not see anything. At the last exhibition organised by the Brighton and Hove Society, the writer managed the compressed air section, and with visions of much neck craning and various other contortions in the past, devised the layout as shown in the photograph. Two trestle tables, each 8 ft. × 2 ft., were allotted, making stand space 16 ft. × 2 ft. It will be noticed that a space was left at the back of the stand, so that maintenance, etc., could be carried out without inconveniencing spectators.

Technical Details

Two six-foot lengths of half-inch gas pipe were procured, and ten ockets were welded on each by our able chairman. Into these sockets were screwed standard brass gas taps. Another method would be to screw short lengths of pipe into tees, or to use wheel valves screwed direct into the pipes; it is just a matter of choice, time, and materials to hand. Into one end of each of the pipes was screwed a large tap, for the following reason. When air is compressed, it has heat extracted, and so enters the pipes at a lower temperature. This causes a certain amount of condensation, but it was found that opening the end tap before closing down for the day, blew away any water that had collected in the pipes. This procedure was carried out for the seven days that the exhibition was on, and not once was there found a trace of water in the engines. Incidentally, if standard gas taps are used, they will be found smoother in action if a smear of tallow is put on the plugs.

Standard $\frac{5}{16}$-in. bore rubber tubing was used to connect up the engines. It was not found necessary to clip the tubing, due to the low pressures employed. Two stages, six feet long, were constructed, comprising 7 in. × 1 in. softwood for the tops, a strip 6 in. wide of hardboard for each of the fronts, and supports either end notched to clear the pipes, or headers, to give them their correct terms. This served not only as a stage for the smaller models (*see* photograph) but hid from view the efficient but inelegant array of gaspipes and taps, incidentally also, a receptacle for the cleaning rags, oilcan, tools and—very important—one's lunch! It will be noticed that the whole has been made in two sections. One reason was to promote portability, and another that a smaller layout on one table could be arranged if desired.

The compressor, a small rotary type, driven by a 1/3 h.p. electric motor, and delivering 4 cu. ft. per min. was loaned to the society for the period of the exhibition. It was just big enough to run all the engines shown on the stand, including a $\frac{3}{4}$-in. scale 4-cylinder "Great Bear" chassis, and also two paddle steamers, both with twin-cylinder engines, at each end of the stand on adjoining tables.

Running Speeds

Full-size steam engines usually run at very low revs. per min. (excepting those specially designed for high speed, of course). Indeed, they could not do otherwise, because of the huge masses of metal involved. The whole beauty of the steam engine is in its slow ponderous movement and its many working parts. From this it goes without saying that the small sisters on the compressed-air stand should do likewise. An engine running in a blur will not evoke much interest, but one slowly ticking over most certainly will.

It is usual at an exhibition to

(*Continued on next page*)

READERS' LETTERS

● **Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.**

FOR MODEL ENGINEER EMIGRANTS

DEAR SIR,—I landed out here in February this year en route to New Zealand, where I hope to settle. I was a member of the Lymington (Hants) M.E.S.

I would like to advise any readers coming out here to bring their lathes, etc. with them if possible. I did, and am glad, as such things are scarce and costly. I took good care to crate all my gear securely and plastered "Ensis" oil over everything. This effectively stopped rusting whilst the stuff was in the ship's hold. The salt atmosphere played Hamlet with some of our metal household goods not treated. I would emphasise the necessity of *secure* packing.

This part of New South Wales —it's close to Newcastle—is mostly concerned with heavy industries and mining. B.H.P. have a big steelworks here, and there is a State dockyard, wire works, railway workshops, etc. Most of the lighter industries are down towards Melbourne. I mention this, as it might assist any intending settler to select the best port for which to aim. (Queensland is mostly farming).

Warners Bay, Yours faithfully,
N.S.W., Australia. F. G. HOBBS.

YOU HAVE BEEN WARNED

DEAR SIR,—I am seriously considering the cancellation of THE MODEL ENGINEER. Inadvertantly, I left my copy dated October 15th, 1953, on my workshop bench. My two grandchildren who only live for things driven by steam saw the article by "L.B.S.C.", "A Simple Steam Crane." Nothing would satisfy them, except that they must have one for Christmas. Being 65 myself, and easily led, I agreed they should have one. This is now working, and lifting articles far in excess of normal practice.

The blow fell, however, when THE MODEL ENGINEER followed up on November 5th with an article by E. T. Westbury on the "Cygnet." Nothing would suit these two fiends but this was just the thing they wanted for driving a small wooden hull I made them four years ago. Being a glutton for punishment, I eventually agreed to make one.

In anticipation of you publishing more articles of a similar nature to these two interesting pieces of machinery, I am now taking the precaution of hiding THE MODEL ENGINEER, so that I will get a little breathing space until after Christmas. In the meantime, more strength to your elbow on such interesting work!

Yours faithfully,
Saltburn. E. A. JUDD.

ACCUMULATOR REPAIRS

DEAR SIR,—I have noticed in your issue for November 19th, a query in connection with a cracked battery casing. The method of repair will not, I am afraid, be very successful, as Chatterton's Compound does not adhere well to hard rubber.

Here is a method which I have employed with complete success on batteries used in W.D. vehicles.

First, the casing is dried. Next, two small *blind* holes are drilled, one at each end of the crack, to prevent spreading. The line of the crack is now enlarged to a width of about ¼ in., to a depth of ⅛ in. The groove is now filled with "Bowes Seal-Fast Tyre Dough." Perhaps Bostik Sealing Compound might serve equally well.

To protect the repair from mechanical damage, the surface is levelled-off and well roughened. Next, ordinary tyre, puncture-repair solution is brushed into the surface and allowed to dry. Finally, a tyre patch is applied to cover the repair and is rolled-on with a Bowes roller or other similar device.

This type of repair was successful in the hands of Italian lorry drivers whose conception of driving consisted largely of chamois-like leaps from boulder to boulder along bomb-damaged roads.

Yours faithfully,
Sutton Valence. S. U. BELSEY.

RUNNING MODELS ON COMPRESSED AIR

(*Continued from previous page*)

lay exhibits on paper, fancy or otherwise. This is, of course, disastrous for the compressed-air stand, as the inevitable splashes of oil will soon make a mess. The writer got hold of some old lino and tacked it down to the tables. A wipe over with a rag periodically kept the stand clean.

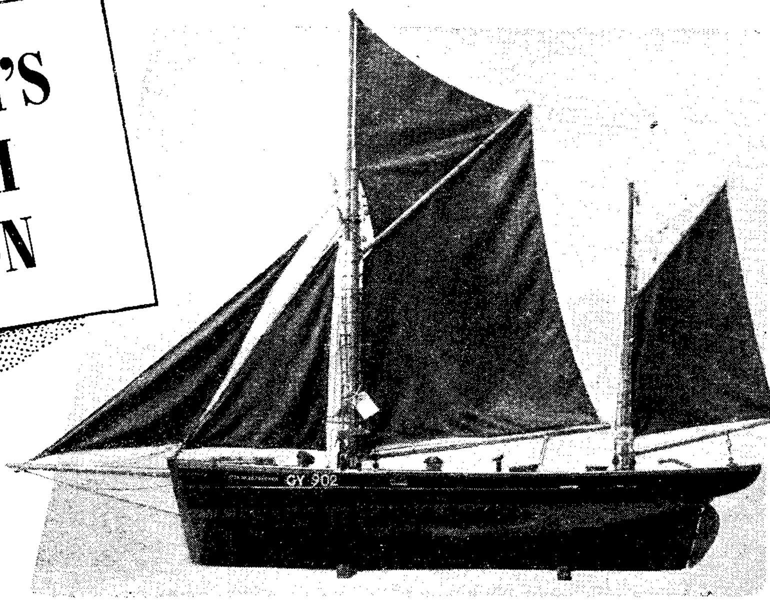
Operating Procedure

A few hints to exhibitors who allow their engines to run will not be amiss at this stage. A short length of pipe (not union nuts) is necessary for connecting up at the inlet. Slacken off gland nuts, because of the low pressures used. Tight glands will only cause unwanted friction and higher pressures than necessary.

Connect rubber tube to inlet pipe; if the latter is narrow (and it invariably is), wind surgical tape on to make up the required thickness. Do not use insulating tape, as it is extremely difficult to push the rubber tubing over it. Lubricate all bearings. Motor-car lubricating oil was found the best to use. For cylinder lubrication, engines fitted with mechanical or cylinder lubricators will be easy to deal with. Displacement lubricators are, or course, useless on compressed air, and the only way will be to squirt oil through the exhaust port. When closing down for the day, first open tap at end of header to blow away any water, and then switch off compressor. Do not touch individual taps. When starting up, after compressor has reached approx. 40 lb., turn on air to the headers, give all the flywheels a turn by hand, and the whole lot will merrily tick over.

It is hoped that these notes will assist exhibition managers of future exhibitions, and that more exhibitors will come forward with their engines for this section. Three of the models shown were built by the writer: The *Rainhill* chassis, the Stuart No. 4 next to it, and the small vertical at the far end. On test, the *Rainhill* chassis still ticked over at slightly less than 1 lb. per sq. in.

NOTTINGHAM'S SIXTEENTH EXHIBITION



This excellent trawler, by A. V. Gregory of Scunthorpe, was on loan to the exhibition

OFFICIALLY opened by His Worship the Lord Mayor, introduced by our vice-president, Mr. A. J. Witty, the exhibition was undoubtedly a great success, and was considered by many visitors to be the best in the twenty-four years of the Nottingham S.M.E.E. Over 200 models were exhibited, covering a wide field of interest, and splendid support was given by kindred societies in the Midlands, also from the Nottingham Model Yacht Club and the Model Car Club. One of the main public attractions was a completely new "OO"-gauge railway which superseded the society's previous "O"-gauge layout.

Six trophies covering the major sections, together with bronze medallions and certificates of merit were available, together with cash awards and certificates for outside exhibitors. The judging was carried out by six of the older members (non-competitive) on a points system, which I venture to conclude proved reasonably satisfactory, although more available time would have eased this difficult task.

The Best Model

The Pool Trophy for the best model in the show was awarded to S. J. Bradley for his undertype compound engine and boiler, a very fine model without frills, to be seen working on the compressed-air display stand. In the marine section the Carr Trophy, donated by Carr & Co., was awarded to a very fine model of a Dutch Tug built by our most versatile member E. W. Sheppard.

The judges had a most difficult time in the locomotive section as usual, especially as two almost identical G.N. Atlantic chassis were in the final running, being the work of E. Brown on the one hand and J. Fletcher on the other. The decision, however, went to Mr. Brown who, incidentally, won the Pool Trophy with a No. "1"-gauge coal-fired 0-6-0 at a previous exhibition. The trophy in this section we call the "Sine Nomini" as it was kindly presented by an anonymous donor at one of our early exhibitions. The Dakin Trophy, given by one of our members, also went to the locomotive section for a *Titch*, unfinished, but showing high class workmanship.

For the first time we had a special trophy for the road locomotive and stationary-engine section (steam) given by another of our members, Mr. A. E. Elliott, and this was awarded to J. Paul for a mill engine and Cornish boiler. Other awards were as follows: Bronze Medal. F. A. Scotton, Broads holiday yacht; J. Fletcher for his G.N.R. Atlantic chassis; T. B. Voase, for a gravity impulsed clock, and F. Allen, for a very nicely finished horizontal mill engine.

The Wallis Binch Trophy for the miscellaneous section went to T. B. Voase for his pendulum ½-sec. electric miniature grandfather clock which created much interest and admiration.

From the exhibits submitted by the kindred societies, mention must be made of a very excellent trawler on loan only, made by A. V. Gregory of Scunthorpe, and a Peckett saddle tank by G. Harris of Loughborough. Many most interesting models were received on loan, in particular two glass-case models from British Railways, and a 2-in. scale G. N. Stirling from Mr. T. G. Hunt of Smethwick. Reference must be made to the magnificent 10¼-in. gauge *Royal Scot* built by S. Battison of Ilkeston, Notts, one of our oldest members. Although this locomotive did not adhere strictly to prototype, having two cylinders only for the obvious reason it is intended for suitability and convenience of a working life, it was greatly admired by our members and our visitors.

The trade was represented by several staunch friends and supporters of previous exhibitions, including Kennion Bros., who must have returned home very much lighter with more paper and less castings.

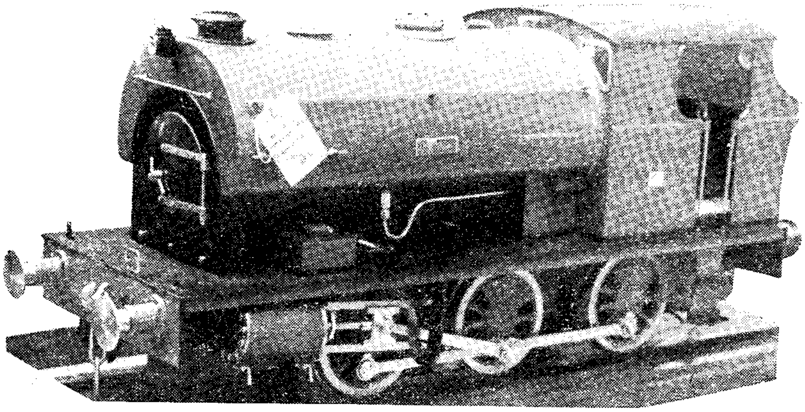
Free Rides

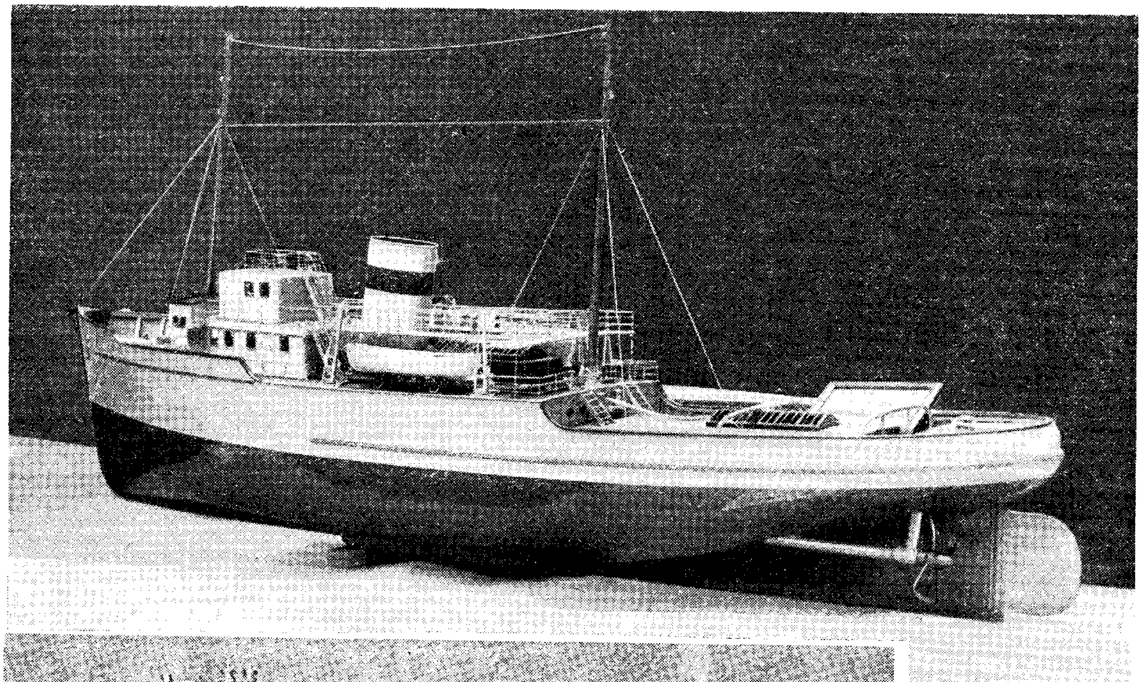
The customary passenger track was in operation throughout the exhibition, a free ride being given to every holder of a child's admission ticket. Our old and respected chairman, Tom Lawson, and also our late secretary, H. Wilshaw, joined us on the Saturday, and a number of other old members and friends linked up with our activities.

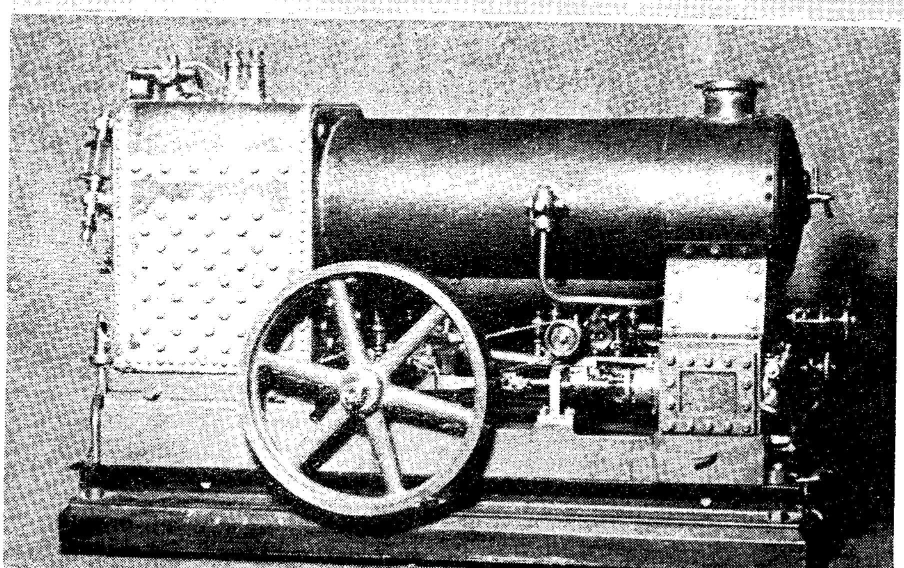
By 9 p.m. on the Saturday although all very tired, we were convinced that we had made this "Coronation Year" Exhibition the success we had aimed for; over 10,000 visitors had supported us, and not one of us had received complaint or adverse criticism. To all those who contributed to the success of our effort, we record our

sincere thanks; wherever we sought assistance and co-operation, it was forthcoming.

On November 11th, members gathered for an organised dinner party, at which our vice-president presided in the absence of our president, J. G. Rollinson, and the awards were presented by Mrs. Witty. We were entertained afterwards by a movie show arranged by our Mr. Coates, the major films showing the society's track activities and pictures taken at the 1953 Birmingham track day.







Top right: A Peckett saddle tank by G. Harris, of Loughborough

Above: This fine model of a Dutch tug, by E. W. Sheppard was awarded the Marine Trophy

Left: The Pool Trophy for the best model in the show was awarded to S. J. Bradley for this undertype compound engine and boiler

QUERIES AND REPLIES

" THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked " Query " and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

High-speed Steel

I have some ½ in. diameter high-speed steel boring bars which have now been reduced at the working end to practically the same diameter as the shank. Is it possible to forge these to give a new working head? If so, what is the best method to employ, and does the tool have to be normalised before hardening; also, please advise how the steel should be hardened, and whether tempering is necessary?

E.McD. (London, N.W.3)

The heat treatment of high-speed steel varies to some extent according to the composition of the steel, and the present tendency is to use steel bits which have been pre-hardened and tempered by the manufacturers.

The method of manufacturing the great majority of ready-made tools, including both tools for boring and external turning, is by resistance-welding short pieces of high-speed steel to carbon-steel shanks; and, generally speaking, when the cutting edges have worn down too far for normal use, they can only be reconditioned by rewelding high-speed steel tips to them.

There is considerable difficulty in forging high-speed steels, owing to their extreme toughness at very high temperatures. Some of these steels can be hardened by heating to dull red, and cooling in an air blast, no further tempering being necessary. In some cases, however, oil quenching is recommended, and it would be necessary to get the advice of the makers of the particular steel for dealing with their product.

Steam Pipes for " Juliet "

I am about to assemble a pair of cylinders for the Gauge " 1 " " Juliet." On the blueprint, the steam pipe flanges are shown screwed in the centre underneath each steam-chest; as the steam-chest covers are held in place by six bolts, it would appear that the steam inlet must go through the centre bolt hole. Is this correct?

The alternative appears to be to offset the flange, but it is hardly possible without breaking into one of the other holes in the steam-chest. As I have not made a locomotive before, I thought it best to get your opinion before I make a mistake.

J.M.R. (Long Eaton).

You have not read the drawing correctly. The flanges you refer to are for the lubricator connections and have nothing to do with the steam supply to the cylinders. You do not state whose drawings you are using, but we think you will find the steam-pipe connections shown separately on another sheet, though we cannot be certain of this. However, if our conjecture is wrong, you will find the necessary information and drawings in THE MODEL ENGINEER for January 22nd, 1947, page 17.

The Ratio of 7 to 10

In your recent reply to L.C. (Ashford), as published in THE MODEL ENGINEER *for December 10th, you recommend the use of " a sort of proportional dividers 8½-in. long, with a pivot at 5-in." Could you explain these dimensions, as they are unintelligible to me, since you say that the dimensions for 3½-in. gauge are increased for 5-in. gauge in the ratio of 7 to 10. How do you arrive at these figures?*

P.F. (London, S.W.1.)

The explanation is simple! The problem is: How to find the dimensions of a 5-in. gauge locomotive when using a drawing for a 3½-in. gauge one. It is, therefore, clear that the required dimensions will be larger than those on the drawing and the increase will be in proportion to the gauge; in other words, the precise ratio is as 3½ is to 5. Doubling these two figures gives 7 and 10, respectively, which are rather more convenient to use, because they are single figures that do not include fractions. But the proportion, of course, is not altered.

The dimension of 8½-in. for the length of our suggested proportional dividers is obtained by adding 3½ and 5, equals 8½ in. If two pieces of wood, metal, or even cardboard, each 8½ in. long, are pivoted together at a point 5-in. from one end of each arm, we obtain a scissors-type of device, the two long arms of which are 5-in. long and the two shorter arms 3½ in. long, measured from the pivot to the end of the arm in each case.

It is scarcely necessary to add that all four ends of the arms should be trimmed back and fitted with needle-points, as in ordinary dividers, care being taken to see that each needle-point projects exactly the same amount from the end of each arm; the precise amount of projection does not matter, but it must be exactly the same for all four points, keeping the overall length 8½ in.

In using this instrument, all that is necessary is to measure the 3½-in. gauge drawing by means of the two shorter arms of the dividers; every dimension measured in this way is automatically enlarged, at the other ends of the dividers, to the correct size for the 5-in. gauge engine. We might add, perhaps, that if the 8½ in. size for these proportional dividers proves to be too small in practice, than a set 17-in. long overall and pivoted at 7-in. could be constructed just as easily, and their proportion would obviously be in the ratio of 7 to 10, which is the same as 3½ to 5. Incidentally, the pivot of the dividers is best made from a screw fitted with a nut, preferably a wing-nut, so that the device can be locked in any desired position of the arms.

CORRESPONDENCE

The Managing Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Correspondence and manuscripts should not be addressed to individuals, but to the Managing Editor, THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

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